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1/14/11

Field Trip Report of
Adrian Brown, PE
Pakootas et al v.
Teck-Cominco Metals Ltd

Prepared for:

Teck Metals, Ltd

Date: January 14, 2011

Project No. 1615A

AdrianBrown

Innovative Environmental Solutions

130 West Fourth Avenue
Denver, Colorado 80223
303.698-9080 Fax 303.698-9241
www.abch2o.com

List of **Attachments**

AdrianBrown

Innovative Environmental Solutions

130 West Fourth Avenue
Denver, Colorado 80223
303.698-9080 Fax 303.698-9241
www.abch2o.com

1 FIELD INSPECTION

As part of the investigation and evaluation of mine-related discharges to Franklin D. Roosevelt Lake ("Lake Roosevelt") by Adrian Brown, P.E., a field inspection was made on April 28-30, 2010. This report documents that field inspection.

2 ITINERARY

The itinerary for the inspection is provided in Attachment 1. The trip was divided into three days, with the following activities:

1. April 28, 2010. Spokane, Mills, Colville, Republic, Kettle River, Canadian smelters, Trail.
2. April 29, 2010. Waneta Dam, ReMac, 7-Mile Dam, Pend Oreille Mine, Grandview, Sierra Zinc, Deep Creek, Anderson-Calhoun, Black Sand Beach.
3. April 30, 2010. Kettle Falls, Bonanza Mine, Northport smelter, Van Stone Mine, Bonanza Mill.

3 OBSERVATIONS

Observations were made during the field trip, and recorded as follows:

1. Field Book. A detailed record of observations and photographs taken was kept by Adrian Brown in a field book. An image copy of the field book pages is included in Attachment 2.
2. Photographs. A total of 409 photographs were taken in the three-day trip. The file name for each photograph is numbered to match descriptions in the Field book, and contains a brief description of the location of the photograph. Attachment 3 contains the following:
   a. A photo log
   b. Copies of the photographs (in folders by day)
   c. Montages of panoramic sets (at the beginning of each day folder for that day)

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ATTACHMENT 1
ITINERARY AND MAPS

AdrianBrown

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Activity	Miles	Time
April 28, 2010		
Leave 8:00 AM		
Mouth Spokane R	58	1:14
River Stop	0	0:30
Kettle Falls	60	1:19
Republic	44	0:58
Republic Cruisearound	0	2:00
Curlew	22	0:28
Greenwood	44	1:35
Greenwood Stop	0	0:30
Grand Forks	26	0:33
Grand Forks Stop		0:30
Trail	67	1:24
Arrive Trail 7:00-7:30 PM		
April 29, 2010		
Begin at 9:00 AM?		
Trail Smelter Tour	0	3:00
Metaline (by Salmo)	55	1:48
Metaline Stop	0	1:00
Leadpoint	31	1:09
Deep Creek touring	0	0:45
Boundary	10	0:16
Black Sand Beach	0	0:30
Northport	10	0:17
Smelter Stop	0	0:45
Bossburg	20	0:25
Colville	23	0:31
Arrive Colville 7:30 PM		
April 30, 2010		
Start 9:00 AM		
Bonanza Mill site	0	0:30
Colville	0	0.
Kettle Falls	9	0:11
Kettle River Overlook	0	0:45
Onion Creek/Van Stone Mine	31	0:41
Marcus Flats Overview	0	0:30
Van Stone Mill and Mine	0	0:45
Colville Highway	20	0:36
Springdale	41	0:49
Ford	12	0:14
Midnite mill overview	0	0:30
Spokane	42	0:52
Arrive Spokane 3:30 PM		

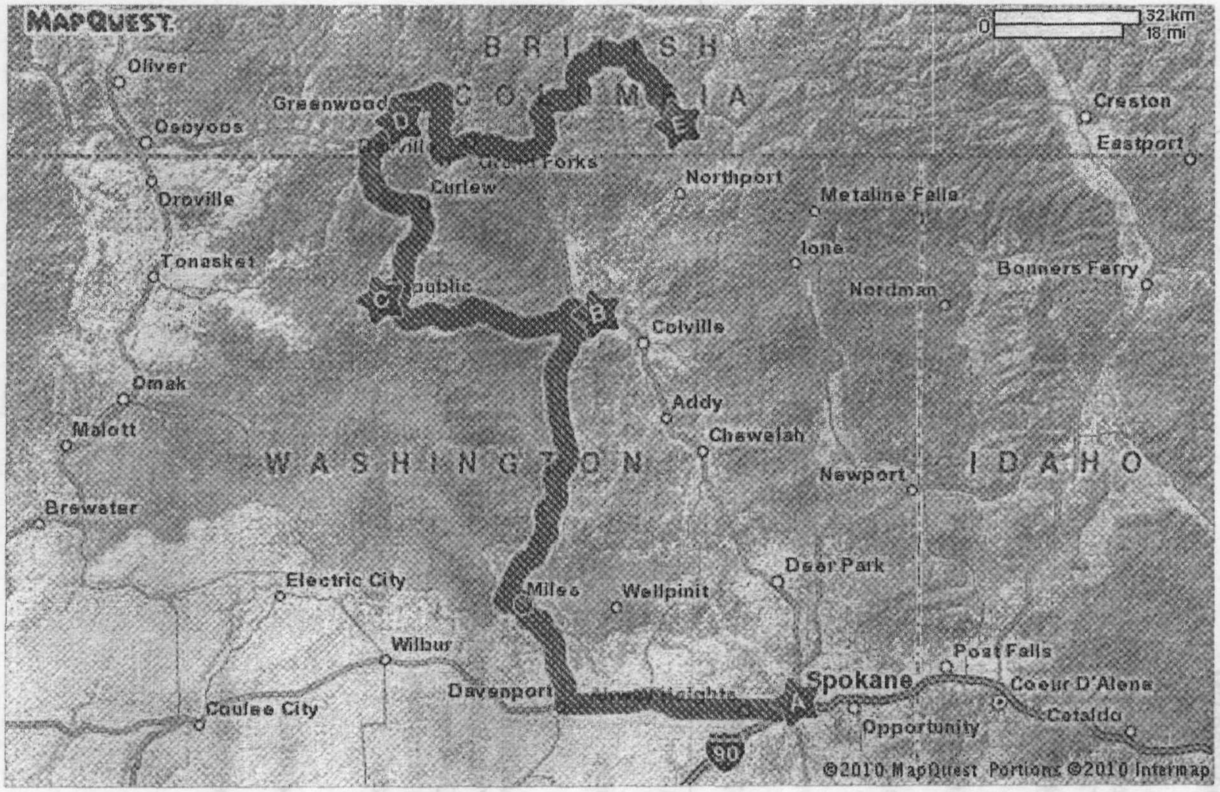
MAPQUEST.

Notes

Trip to Rossland, BC

290.78 miles - about 6 hours 35 minutes

Route Map Hide



 | Map Legend

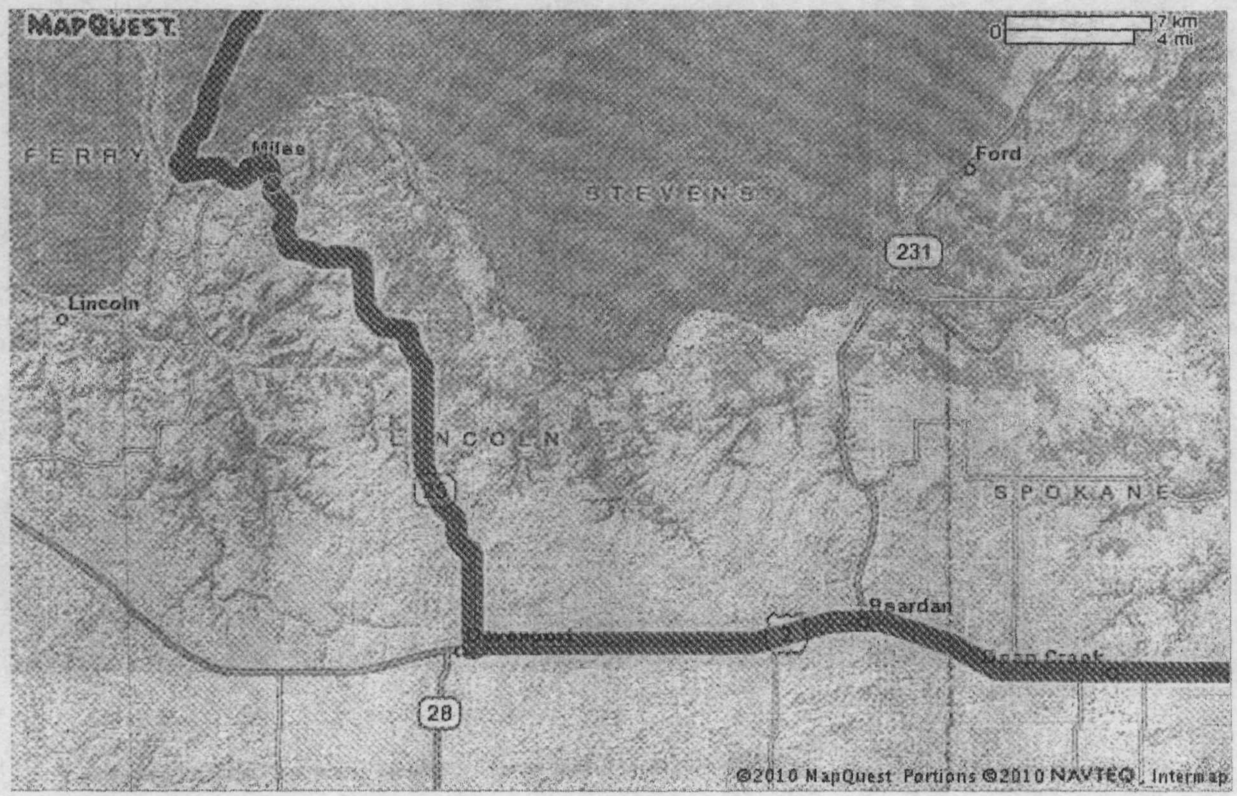
MAPQUEST.

Trip to Kettle Falls, WA

116.99 miles - about 2 hours 22 minutes

Notes

Route Map Hide



MAPQUEST.

Sorry! When printing directly from the browser your directions or map may not print correctly. For best results, try clicking the Printer-Friendly button.

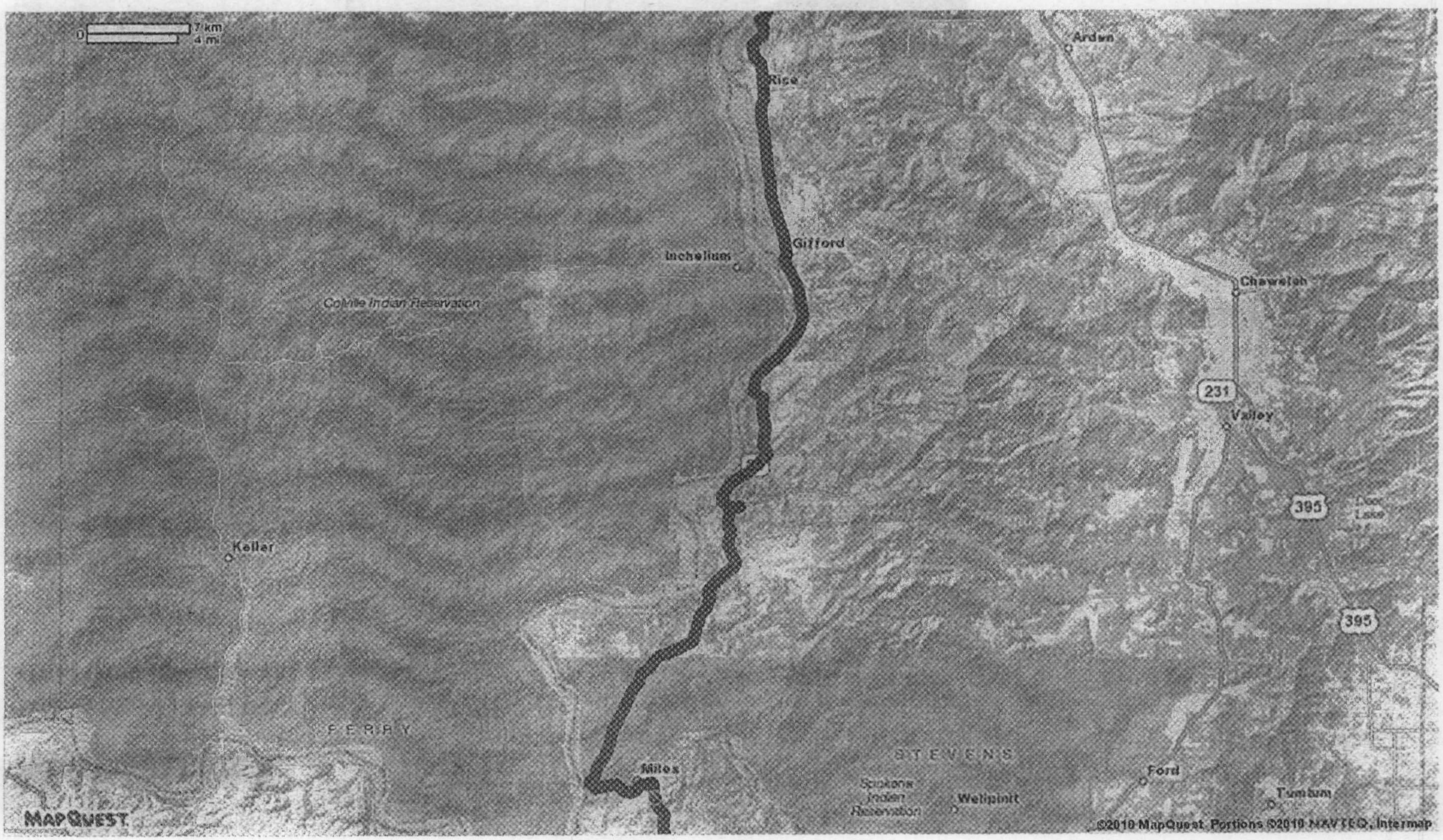
Starting Location

Spokane, WA

Ending Location

Kettle Falls, WA

Total Travel Estimate: **2 hours 22 minutes** / **116.99 miles** Fuel Cost: Calculate



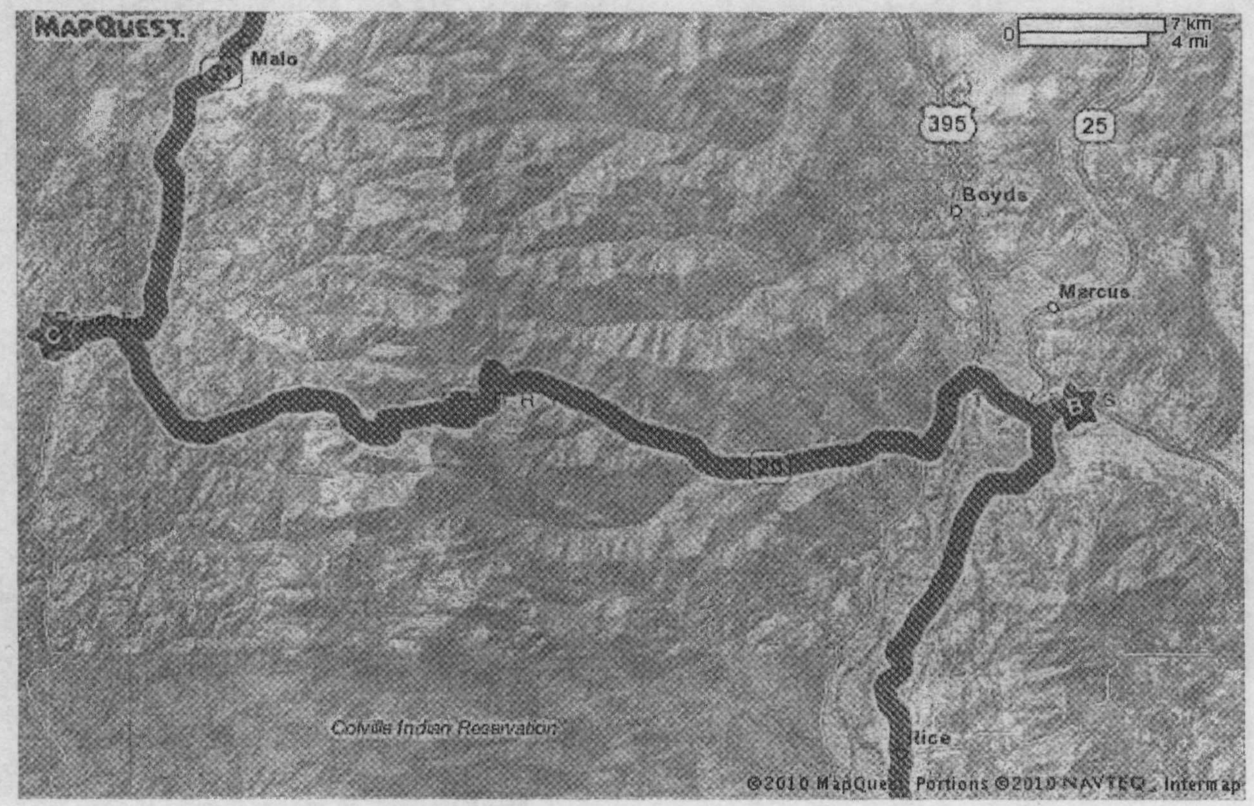
MAPQUEST.

Notes

Trip to Greenwood, BC

204.80 miles - about 4 hours 48 minutes

Route Map Hide



MAPQUEST.

Sorry! When printing directly from the browser your directions or map may not print correctly. For best results, try clicking the Printer-Friendly button.

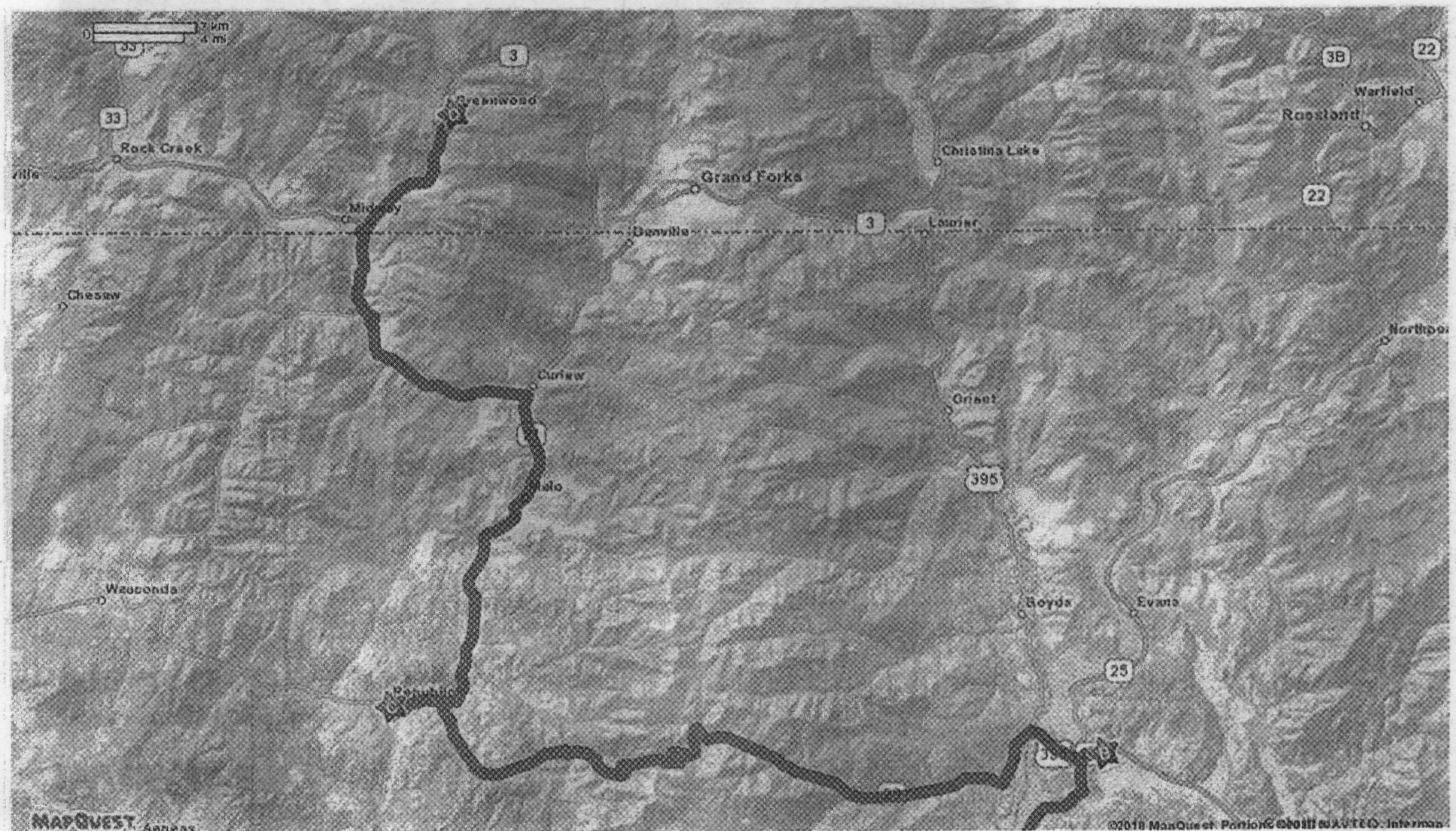
Starting Location

Spokane, WA

Ending Location

Greenwood, BC
Canada

Total Travel Estimate: **4 hours 48 minutes / 204.80 miles** Fuel Cost: Calculate



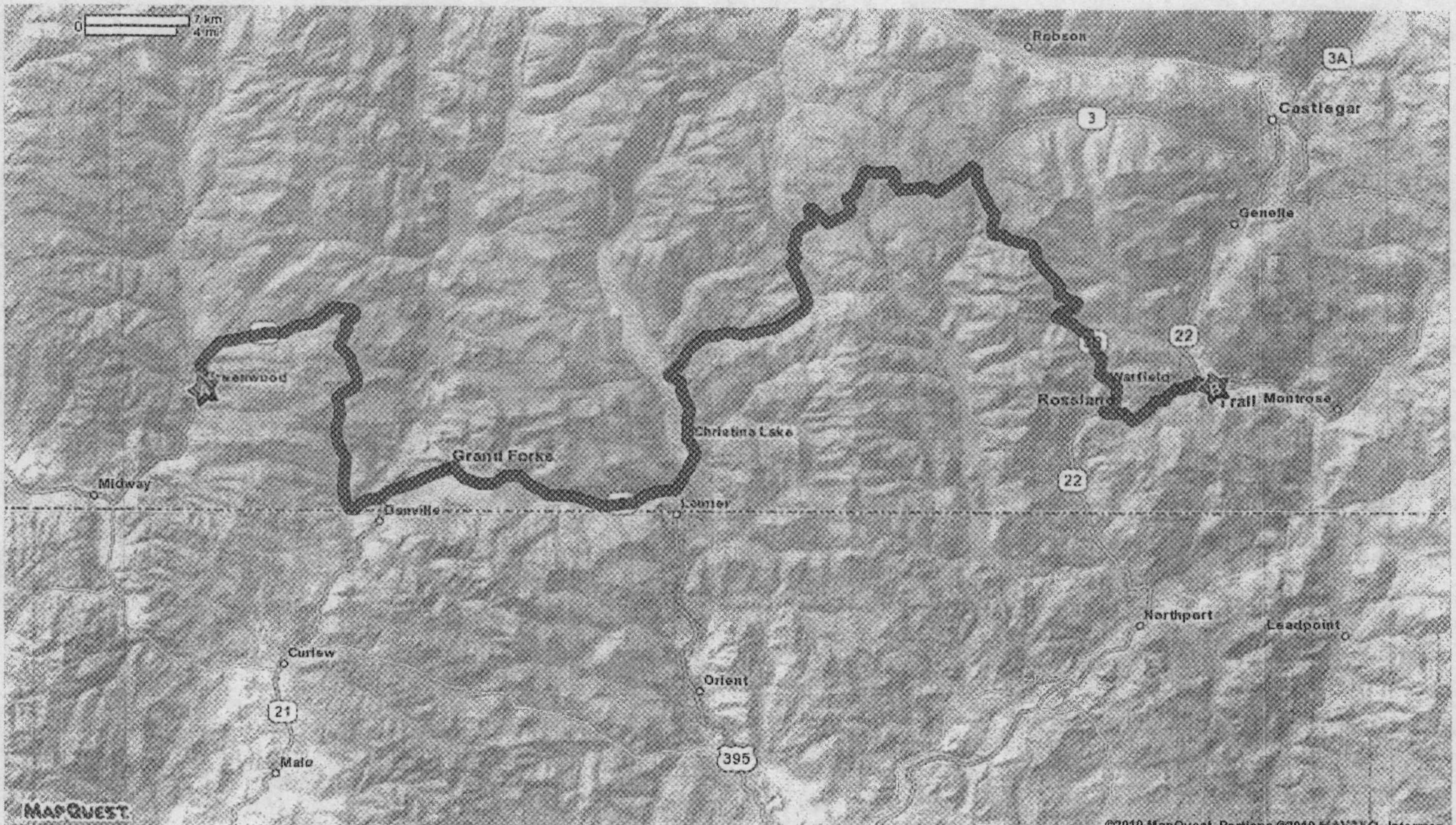
MAPQUEST.

Sorry! When printing directly from the browser your directions or map may not print correctly. For best results, try clicking the Printer-Friendly button.

Starting Location
Greenwood, BC

Ending Location
Trail, BC

Total Travel Estimate: **1 hour 59 minutes / 91.45 miles** Fuel Cost: Calculate



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20100428	1615A_20100428_AB_Boundary Falls Smelter slag undercutting.jpg	1/17/2011 11:45
20100428	1615A_20100428_AB_Boundary Falls Smelter slag.jpg	1/17/2011 11:39
20100428	1615A_20100428_AB_Grand Forks Smelter slag.jpg	1/17/2011 11:55
20100428	1615A_20100428_AB_Greenwood Smelter slag.jpg	1/17/2011 11:50
20100428	1615A_20100428_AB_Knob Hill Mine-Higher.jpg	1/17/2011 11:21
20100428	1615A_20100428_AB_Knob Hill Mine-Lower.jpg	1/17/2011 11:15
20100428	1615A_20100428_AB_Knob Hill Mine-Middle.jpg	1/17/2011 11:20
20100428	1615A_20100428_AB_Myers Falls Dam at Colville River.jpg	1/17/2011 10:53
20100428	1615A_20100428_AB_Myers Falls Dam Spillway at Colville River.jpg	1/17/2011 11:13
20100428	1615A_20100428_AB_Spokane River at Miles.jpg	1/17/2011 9:50
20100428	1615A_20100428_AB_Spokane River at Miles-Upstream.jpg	1/17/2011 9:54
20100428	IMG_3622-Spokane River-Miles.jpg	4/28/2010 8:15
20100428	IMG_3623-Spokane River-Miles.jpg	4/28/2010 8:15
20100428	IMG_3624-Spokane River-Miles.jpg	4/28/2010 8:15
20100428	IMG_3625-Spokane River-Miles.jpg	4/28/2010 8:15
20100428	IMG_3626-Spokane River-Miles.jpg	4/28/2010 8:15
20100428	IMG_3627-Spokane River-Miles.jpg	4/28/2010 8:28
20100428	IMG_3628-Spokane River-Miles.jpg	4/28/2010 8:28
20100428	IMG_3629-Gifford Ferry on LR.jpg	4/28/2010 10:22
20100428	IMG_3630-Colville River Mouth on LR.jpg	4/28/2010 11:01
20100428	IMG_3631-Colville River Mouth on LR.jpg	4/28/2010 11:01
20100428	IMG_3632-Colville River Mouth on LR.jpg	4/28/2010 11:01
20100428	IMG_3633-Meyers Falls Dam.jpg	1/17/2011 10:43
20100428	IMG_3634-Meyers Falls Dam.jpg	1/17/2011 10:43
20100428	IMG_3635-Meyers Falls Dam.jpg	1/17/2011 10:43
20100428	IMG_3636-Meyers Falls Dam.jpg	1/17/2011 10:43
20100428	IMG_3637-Meyers Falls Dam.jpg	4/28/2010 11:25
20100428	IMG_3638-Meyers Falls Dam.jpg	4/28/2010 11:26
20100428	IMG_3639-Meyers Falls Dam.jpg	4/28/2010 11:26
20100428	IMG_3640-Meyers Falls Dam.jpg	4/28/2010 11:26
20100428	IMG_3641-Meyers Falls Dam.jpg	4/28/2010 11:26
20100428	IMG_3642-Meyers Falls Dam.jpg	4/28/2010 11:26
20100428	IMG_3643-Meyers Falls Dam.jpg	4/28/2010 11:27
20100428	IMG_3644-Meyers Falls Dam.jpg	4/28/2010 11:27
20100428	IMG_3645-Meyers Falls Dam.jpg	4/28/2010 11:27
20100428	IMG_3646-Meyers Falls Dam.jpg	4/28/2010 11:31
20100428	IMG_3647-Knob Hill Mine.jpg	4/28/2010 13:28
20100428	IMG_3648-Knob Hill Mine.jpg	4/28/2010 13:28
20100428	IMG_3649-Knob Hill Mine.jpg	4/28/2010 13:28
20100428	IMG_3650-Knob Hill Mine.jpg	4/28/2010 13:28
20100428	IMG_3651-Knob Hill Mine.jpg	4/28/2010 13:28
20100428	IMG_3652-Knob Hill Mine.jpg	4/28/2010 13:38
20100428	IMG_3653-Knob Hill Pano.jpg	4/28/2010 13:39
20100428	IMG_3654-Knob Hill Pano.jpg	4/28/2010 13:39
20100428	IMG_3655--Knob Hill Pano.jpg	4/28/2010 13:39
20100428	IMG_3656-Knob Hill tailings-lower.jpg	4/28/2010 13:40
20100428	IMG_3657-Knob Hill Mill Bulidings.jpg	4/28/2010 13:41
20100428	IMG_3658-Knob Hill Warning.jpg	4/28/2010 13:49
20100428	IMG_3659-Knob Hill tailings.jpg	4/28/2010 13:49
20100428	IMG_3660-Knob Hill Tailings.jpg	4/28/2010 13:50
20100428	IMG_3661-Knob Hill Stream below.jpg	1/17/2011 11:25
20100428	IMG_3662-Knob Hill Stream below.jpg	1/17/2011 11:26
20100428	IMG_3663-San Poil River below Republic.jpg	4/28/2010 14:15

FOLDER	FILE NAME	DATE/TIME (MST)
20100428	IMG_3664-San Poil River below Republic.jpg	12/15/2010 5:48
20100428	IMG_3665-San Poil River 3 mi below Republic.jpg	1/17/2011 11:32
20100428	IMG_3666-San Poil River below Republic.jpg	4/28/2010 14:16
20100428	IMG_3667-San Poil River below Republic.jpg	4/28/2010 14:16
20100428	IMG_3668-San Poil River below Republic.jpg	4/28/2010 14:16
20100428	IMG_3669-San Poil River below Republic.jpg	4/28/2010 14:16
20100428	IMG_3670-San Poil River below Republic.jpg	4/28/2010 14:16
20100428	IMG_3671-San Poil River below Republic.jpg	4/28/2010 14:16
20100428	IMG_3672-San Poil River below Republic.jpg	4/28/2010 14:16
20100428	IMG_3673-Granite Creek Confluence with San Poil.jpg	4/28/2010 14:21
20100428	IMG_3674-Granite Creek nr Confluence (beaver dams).jpg	4/28/2010 14:22
20100428	IMG_3675-Kettle River at bridge.jpg	4/28/2010 14:48
20100428	IMG_3676-Kettle River at Bridge.jpg	4/28/2010 14:50
20100428	IMG_3677-Boundary Falls slag.jpg	4/28/2010 16:04
20100428	IMG_3678-Boundary Falls slag.jpg	4/28/2010 16:07
20100428	IMG_3679-Boundary Falls slag.jpg	4/28/2010 16:07
20100428	IMG_3680-Boundary Falls slag.jpg	4/28/2010 16:07
20100428	IMG_3681-Boundary Falls slag.jpg	4/28/2010 16:07
20100428	IMG_3682-Boundary Falls slag undercutting.jpg	1/17/2011 11:40
20100428	IMG_3683-Boundary Falls slag undercutting.jpg	1/17/2011 11:40
20100428	IMG_3684-Boundary Falls slag undercutting.jpg	1/17/2011 11:40
20100428	IMG_3685-Boundary Falls slag undercutting.jpg	1/17/2011 11:40
20100428	IMG_3686-Boundary Falls slag undercutting.jpg	4/28/2010 16:10
20100428	IMG_3687-Boundary Falls slag undercutting.jpg	4/28/2010 16:10
20100428	IMG_3688-Greenwood Smelter.jpg	4/28/2010 16:21
20100428	IMG_3689-Greenwood Smelter.jpg	4/28/2010 16:21
20100428	IMG_3690-Greenwood Smelter.jpg	4/28/2010 16:21
20100428	IMG_3691-Greenwood Smelter.jpg	4/28/2010 16:21
20100428	IMG_3692-Greenwood Smelter.jpg	1/17/2011 11:48
20100428	IMG_3693-Greenwood Smelter.jpg	1/17/2011 11:48
20100428	IMG_3694-Greenwood Smelter.jpg	1/17/2011 11:48
20100428	IMG_3695-Greenwood Smelter.jpg	4/28/2010 16:32
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20100428	IMG_3697-Greenwood Smelter.jpg	4/28/2010 16:33
20100428	IMG_3698-Greenwood Smelter.jpg	4/28/2010 16:33
20100428	IMG_3699-Greenwood Smelter.jpg	4/28/2010 16:33
20100428	IMG_3700-Greenwood Smelter.jpg	4/28/2010 16:33
20100428	IMG_3701-Greenwood Smelter.jpg	1/17/2011 11:52
20100428	IMG_3702-Greenwood Smelter.jpg	4/28/2010 16:37
20100428	IMG_3703-Greenwood Smelter.jpg	4/28/2010 16:40
20100428	IMG_3704-Greenwood Smelter-stream beneath.jpg	1/17/2011 11:52
20100428	IMG_3705-Grand Forks Smelter slag.jpg	4/28/2010 17:34
20100428	IMG_3706-Grand Forks Smelter slag.jpg	4/28/2010 17:34
20100428	IMG_3707-Grand Forks Smelter slag.jpg	4/28/2010 17:34
20100428	IMG_3708-Grand Forks Smelter slag.jpg	4/28/2010 17:34
20100428	IMG_3709-Grand Forks Smelter slag.jpg	4/28/2010 17:34
20100428	IMG_3710-Grand Forks Smelter slag.jpg	4/28/2010 17:34
20100428	IMG_3711-Grand Forks Smelter slag.jpg	4/28/2010 17:34
20100428	IMG_3712-Grand Forks Smelter slag.jpg	4/28/2010 17:34

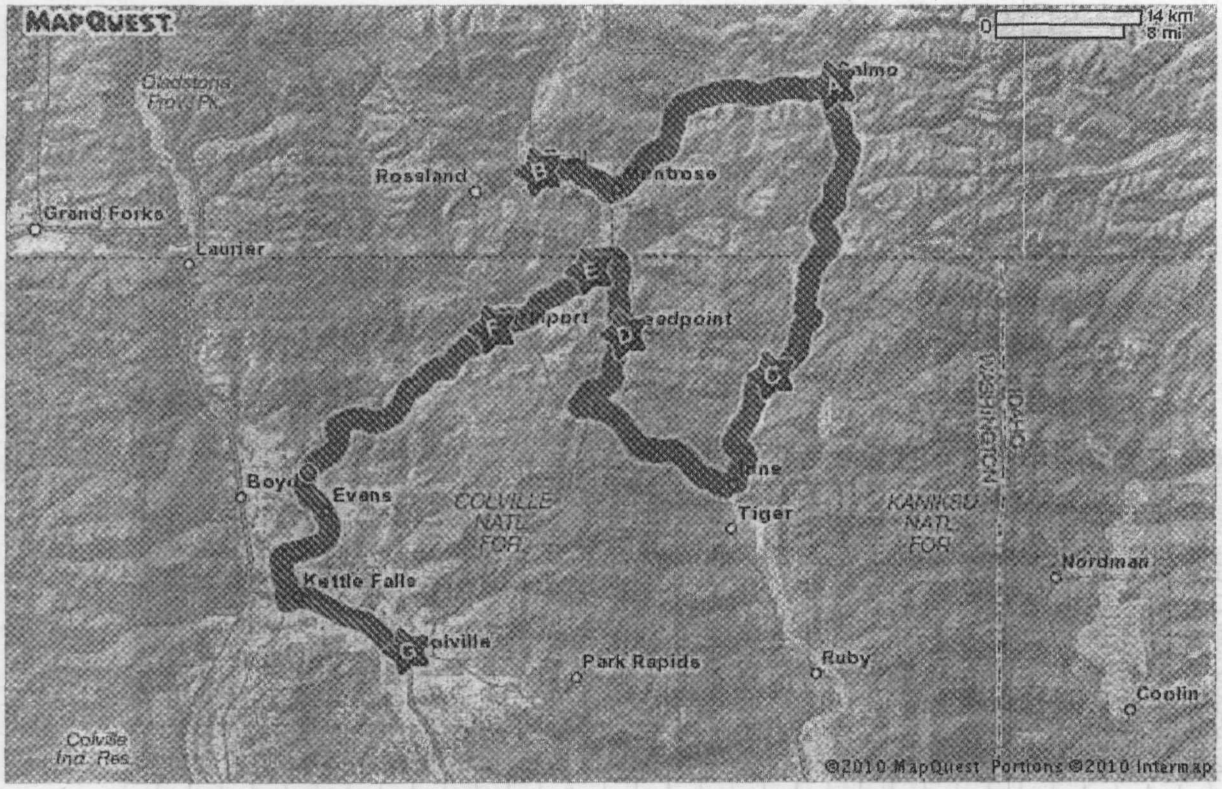
MAPQUEST.

Notes

Trip to Colville, WA

171.90 miles - about 5 hours 3 minutes

Route Map Hide



 | Map Legend

MAPQUEST.

Sorry! When printing directly from the browser your directions or map may not print correctly. For best results, try clicking the Printer-Friendly button.

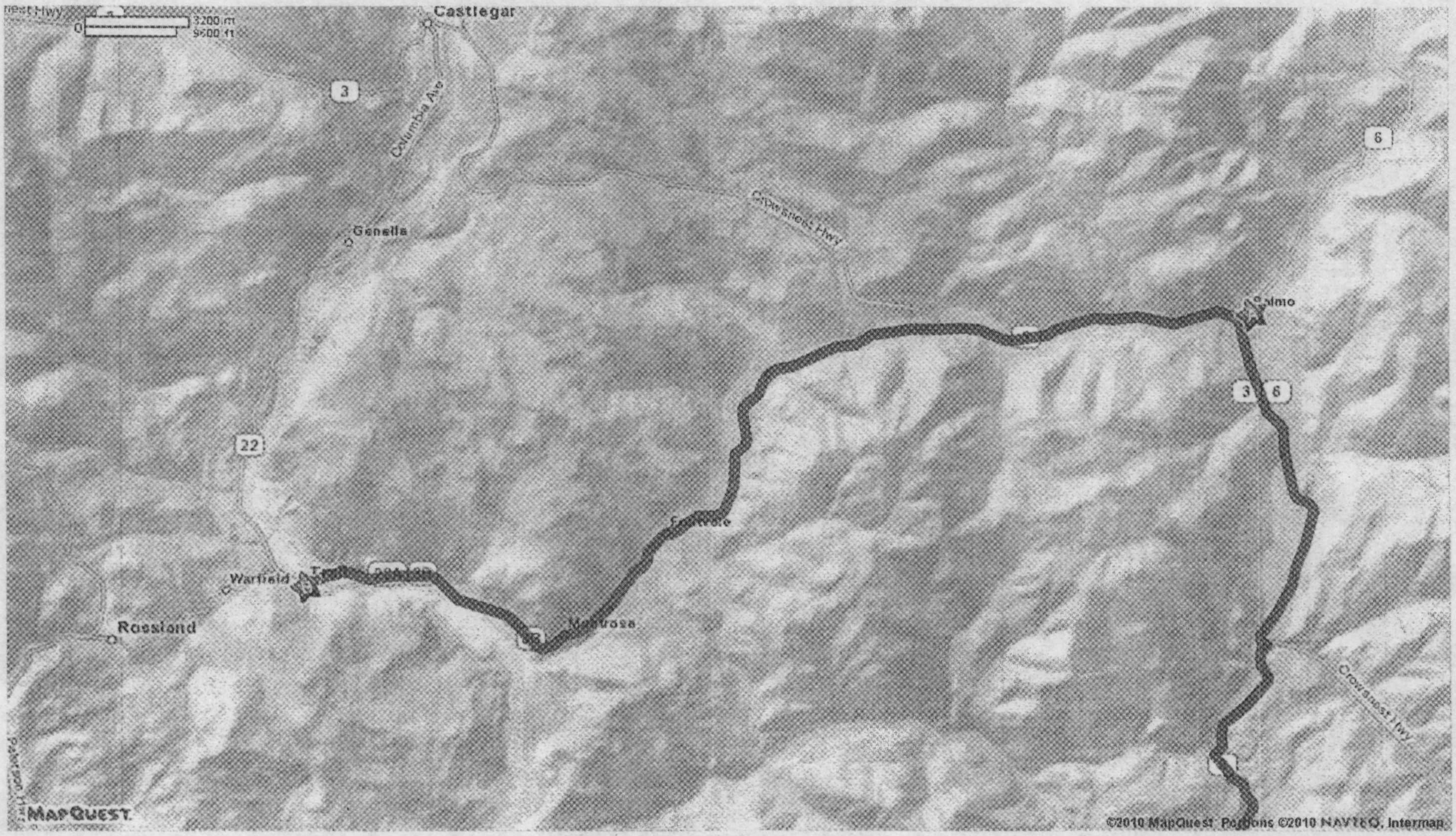
Starting Location

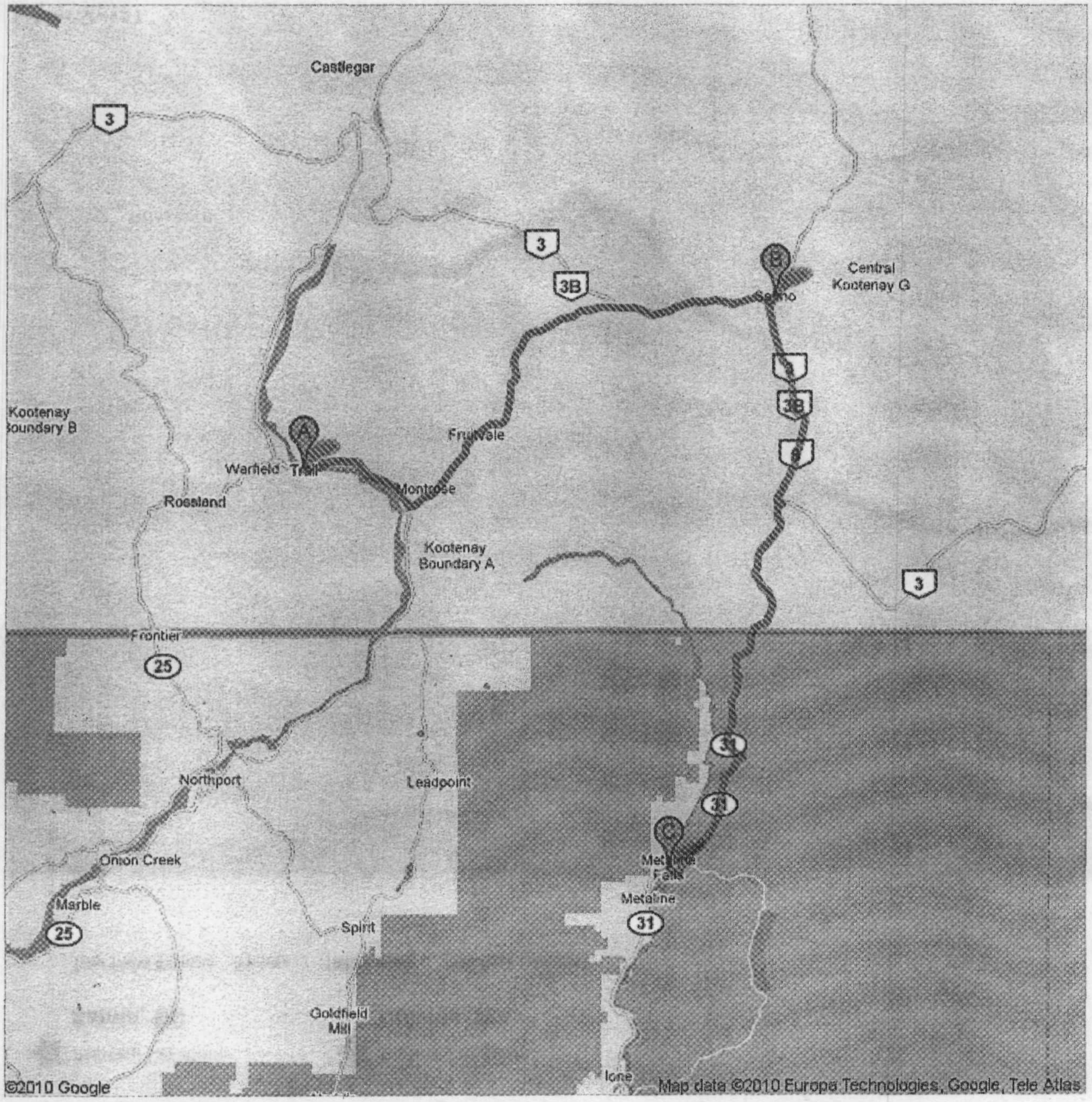
Salmo, BC

Ending Location

Colville, WA

Total Travel Estimate: **5 hours / 164.44 miles** Fuel Cost: Calculate

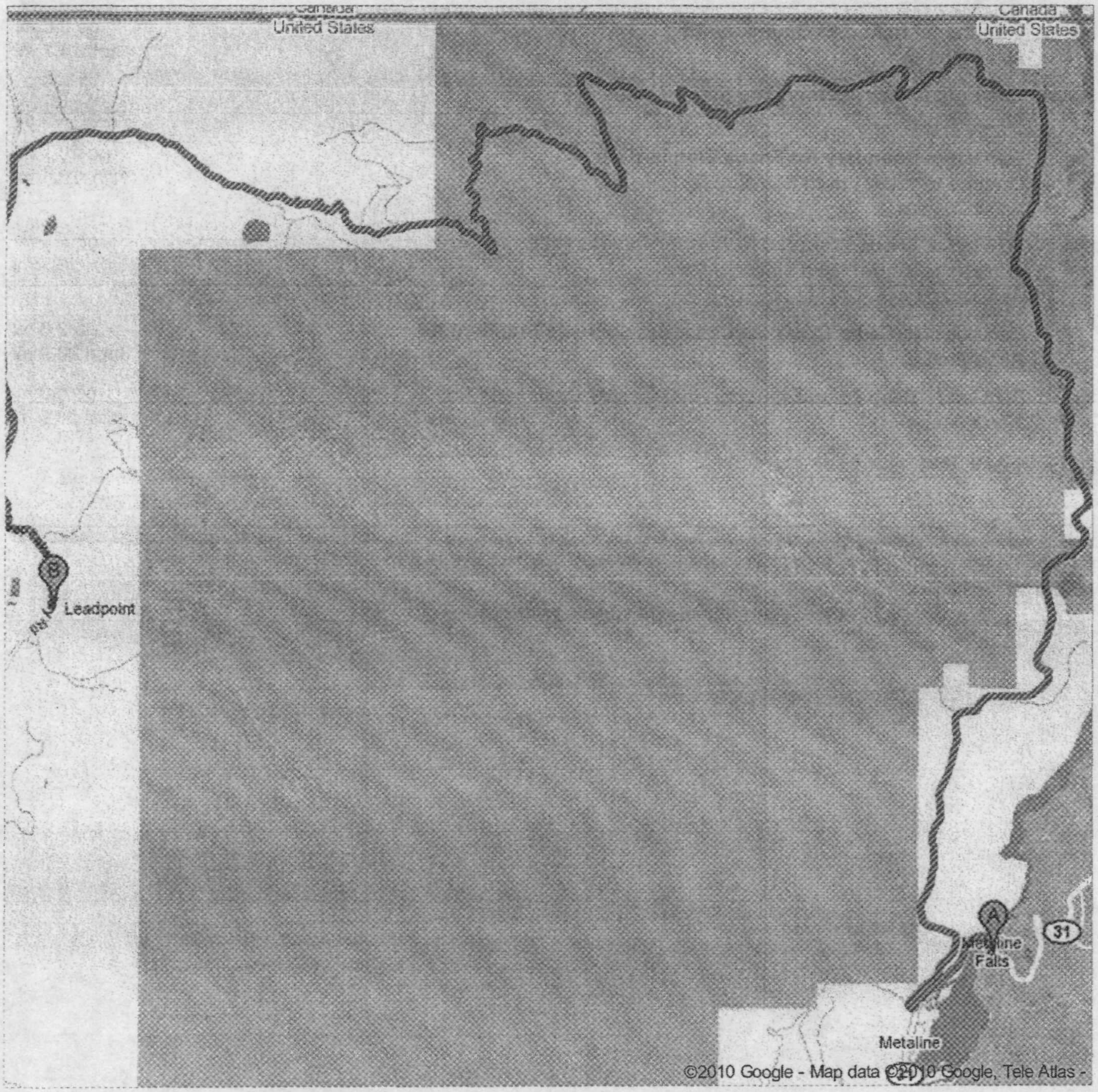




Castlegar
3
3
3B
Central
Kootenay G
Salmo
3
3B
6
Kootenay
Boundary B
Fruitvale
Warfield
Trail
Montrose
Rossland
Kootenay
Boundary A
3
Frontier
25
31
Northport
Leadpoint
31
Onion Creek
Metaline
Falls
Metaline
Marble
25
31
Spirit
Goldfield
Mill
Ione
©2010 Google
Map data ©2010 Europa Technologies, Google, Tele Atlas

Google maps

Directions to Leadpoint, WA
33.9 mi – about **1 hour 21 mins**



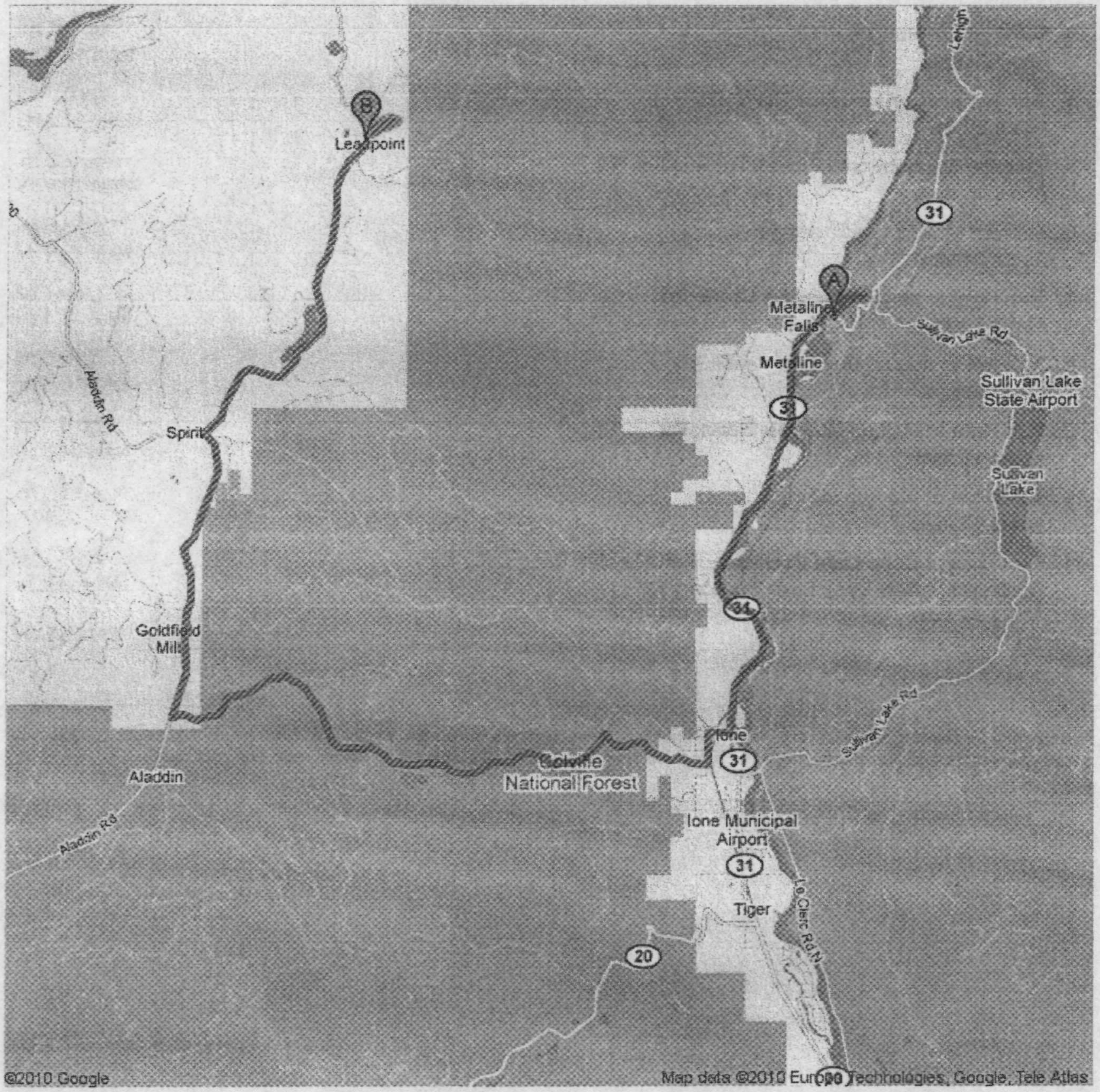
Metaline Falls, WA

1. Head **northeast** on **Grandview St** toward **Lehigh Ave**	go 33 ft total 33 ft
31 2. Turn **left** at **WA-31 S** About 3 mins	go 1.1 mi total 1.1 mi
3. Take the 1st **right** onto **Boundary Rd** About 9 mins	go 3.6 mi total 4.7 mi
4. Turn **right** to stay on **Boundary Rd** About 16 mins	go 6.7 mi total 11.4 mi
5. Turn **left** at **Boundary Rd/Frisco Standard Rd** Continue to follow Frisco Standard Rd About 26 mins	go 10.7 mi total 22.1 mi
6. Turn **left** at **Frisco Standard Rd/Nat for Dev Rd 6270** Continue to follow Frisco Standard Rd About 10 mins	go 4.1 mi total 26.3 mi
7. Continue onto **Cedar Creek Rd/Cedar Creek-Frisco Standard Rd** About 6 mins	go 2.6 mi total 28.9 mi
8. Turn **left** at **Deep Lake Boundary Rd/Lakeside Deep Lake Rd** About 9 mins	go 5.0 mi total 33.9 mi

Leadpoint, WA

Google maps

Directions to Leadpoint, WA
38.4 mi – about **1 hour 33 mins**



Metaline Falls, WA

	1. Head **northeast** on **Grandview St** toward **Lehigh Ave**	go 33 ft total 33 ft
31	2. Turn **left** at **WA-31 S** About 18 mins	go 10.2 mi total 10.2 mi
	3. Turn **right** at **Houghton St** About 2 mins	go 0.4 mi total 10.6 mi
	4. Turn **left** at **8th Ave/Cedar Creek Rd** About 2 mins	go 0.7 mi total 11.3 mi
	5. Take the 3rd **right** onto **Pickett Rd/Stecker Rd** About 10 mins	go 2.5 mi total 13.8 mi
	6. Turn **left** at **Meadow Creek Rd** About 14 mins	go 3.6 mi total 17.4 mi
	7. Turn **right** to stay on **Meadow Creek Rd** About 3 mins	go 0.7 mi total 18.1 mi
	8. Turn **left** to stay on **Meadow Creek Rd** About 2 mins	go 0.5 mi total 18.6 mi
	9. Turn **right** to stay on **Meadow Creek Rd** About 17 mins	go 6.0 mi total 24.6 mi
	10. Turn **right** at **Aladdin Rd** About 11 mins	go 6.1 mi total 30.7 mi
	11. Turn **right** at **Deep Lake Boundary Rd/Lakeside Deep Lake Rd** Continue to follow Deep Lake Boundary Rd About 14 mins	go 7.7 mi total 38.4 mi

Leadpoint, WA

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Directions weren't right? Please find your route on maps.google.com and click "Report a problem" at the bottom left.

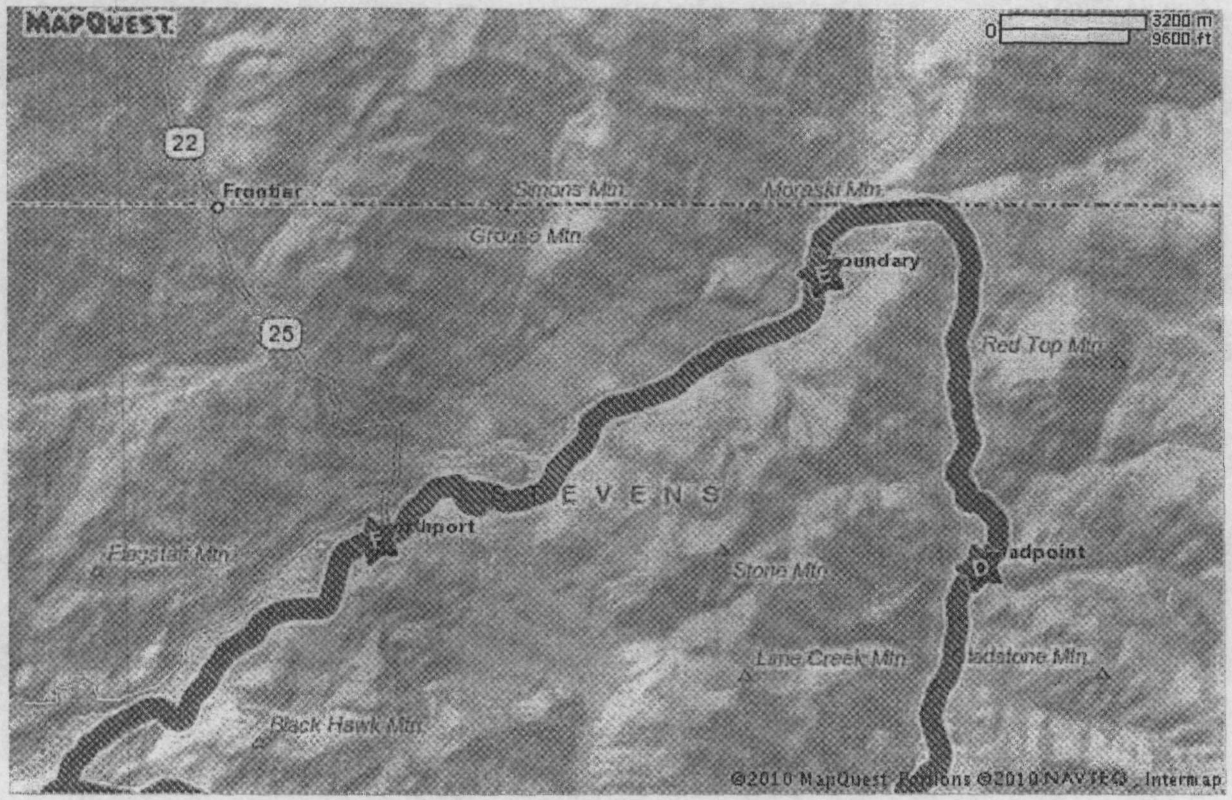
MAPQUEST.

Trip to Colville, WA

164.44 miles - about 5 hours

Notes

Route Map Hide



MAPQUEST.

Sorry! When printing directly from the browser your directions or map may not print correctly. For best results, try clicking the Printer-Friendly button.

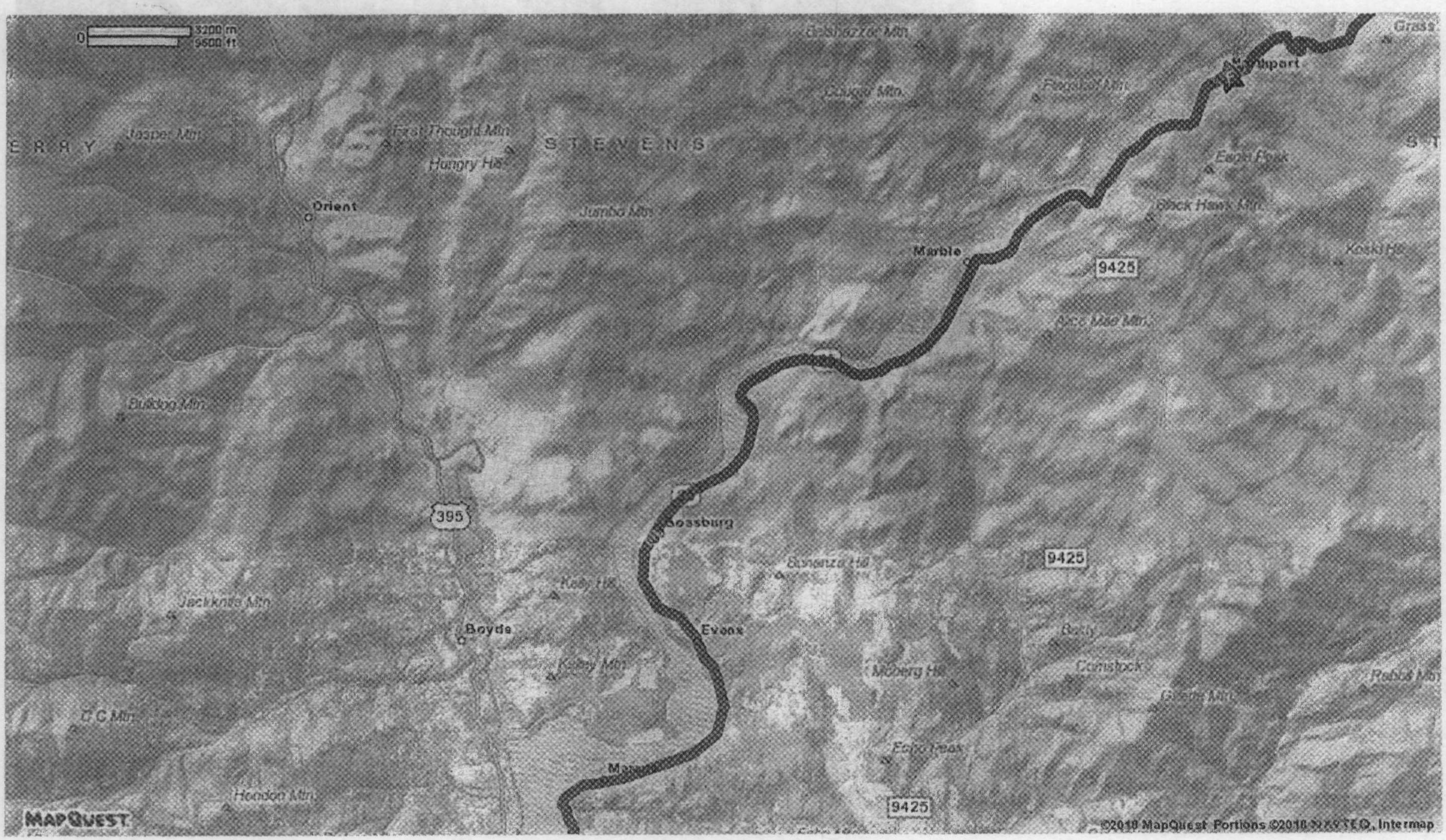
Starting Location

Salmo, BC

Ending Location

Colville, WA

Total Travel Estimate: **5 hours 3 minutes / 171.90 miles** Fuel Cost: Calculate



MAPQUEST.

Sorry! When printing directly from the browser your directions or map may not print correctly. For best results, try clicking the Printer-Friendly button.

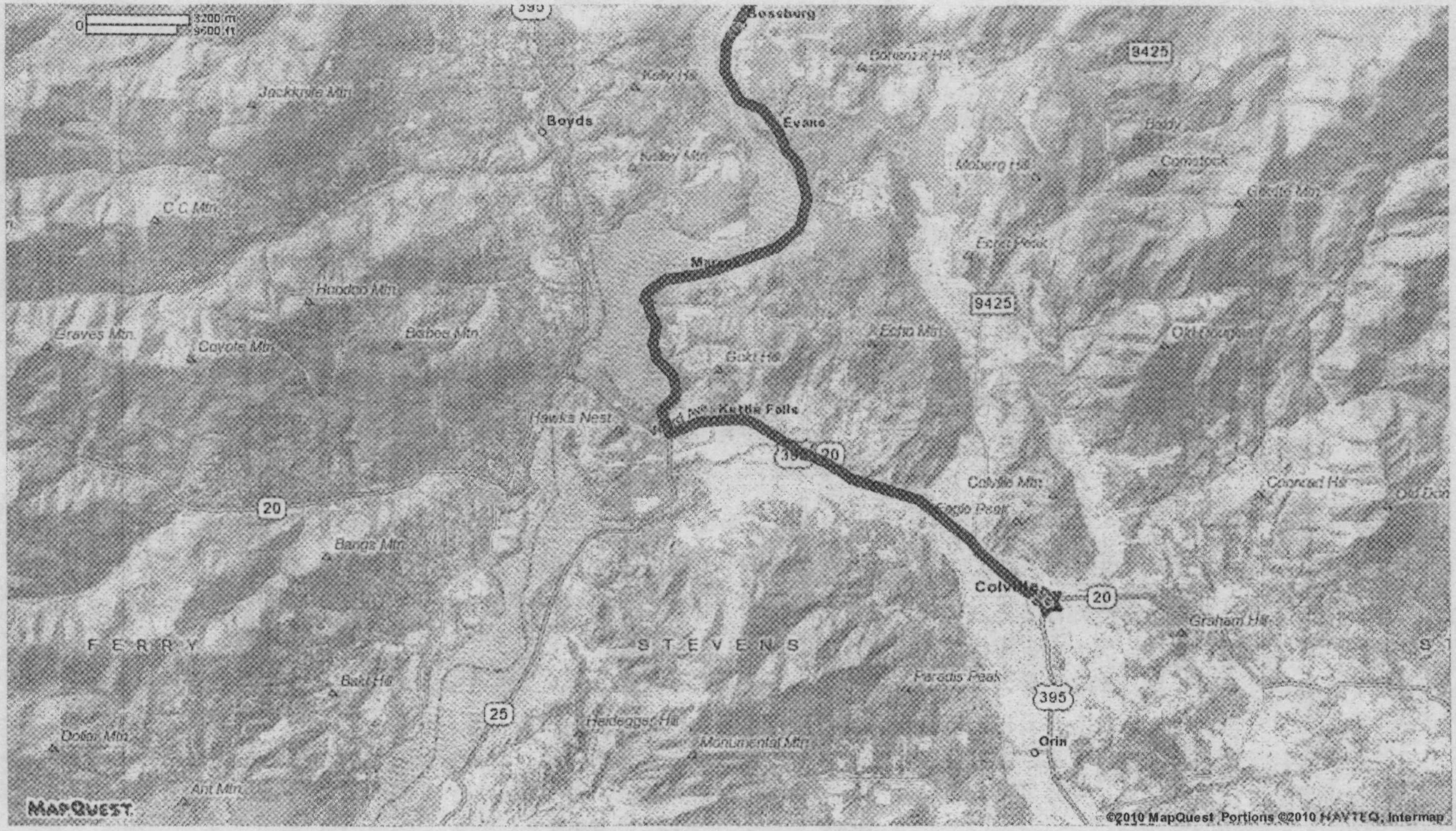
Starting Location

Salmo, BC

Ending Location

Colville, WA

Total Travel Estimate: **5 hours 3 minutes** / **171.90 miles** Fuel Cost: Calculate



FOLDER	FILE NAME	DATE/TIME (MST)
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20100429	1615A_20100429-7 Mile Reservoir at ReMac.jpg	1/17/2011 12:22
20100429	1615A_20100429-Anderson Calhoun Mill-SE.jpg	1/18/2011 4:35
20100429	1615A_20100429-Black Sand Beach.jpg	1/18/2011 4:41
20100429	1615A_20100429--Columbia River (right) confluence with Pend Oreille (left).jpg	1/17/2011 12:08
20100429	1615A_20100429--Columbia River below Trail.jpg	1/17/2011 12:00
20100429	1615A_20100429-Deep Creek Mine at Gate.jpg	1/18/2011 4:05
20100429	1615A_20100429-Deep Lake.jpg	1/18/2011 4:27
20100429	1615A_20100429-Deep Lake-1.jpg	1/18/2011 4:29
20100429	1615A_20100429-Grandview Mill.jpg	1/17/2011 12:33
20100429	1615A_20100429-Grandview tailings.jpg	1/18/2011 3:40
20100429	1615A_20100429-Pend Oreille Mine Tailings Pond.jpg	1/17/2011 12:31
20100429	1615A_20100429-ReMac Crossing.jpg	1/17/2011 12:28
20100429	1615A_20100429-Reves Macdonald Mine.jpg	1/17/2011 12:25
20100429	1615A_20100429-Salmo River with tailings.jpg	1/17/2011 12:19
20100429	1615A_20100429-Sierra Zinc Deep Creek-1.jpg	1/18/2011 3:53
20100429	1615A_20100429-Sierra Zinc Deep Creek-2.jpg	1/18/2011 3:56
20100429	1615A_20100429-Sierra Zinc Deep Creek-3.jpg	1/18/2011 4:02
20100429	1615A_20100429-Sierra Zinc Mill.jpg	1/18/2011 3:45
20100429	1615A_20100429-Sierra Zinc Mill-2.jpg	1/18/2011 3:48
20100429	1615A_20100429-Sierra Zinc Mill-3.jpg	1/18/2011 3:50
20100429	1615A_20100429-Sierra Zinc Tails.jpg	1/18/2011 3:22
20100429	1615A_20100429-Sierra Zinc Tails-1.jpg	1/18/2011 3:37
20100429	1615A_20100429-Sierra Zinc Tails-2.jpg	1/18/2011 3:42
20100429	1615A_20100429-Waneta Reservoir above dam.jpg	1/17/2011 12:11
20100429	IMG_3713-Trail Hotel.jpg	4/29/2010 11:17
20100429	IMG_3714-Columbia River below Trail.jpg	4/29/2010 12:09
20100429	IMG_3715-Columbia River below Trail.jpg	4/29/2010 12:09
20100429	IMG_3716-Columbia River below Trail.jpg	4/29/2010 12:09
20100429	IMG_3717-Columbia River below Trail.jpg	4/29/2010 12:10
20100429	IMG_3718_Waneta Dam.jpg	4/29/2010 12:28
20100429	IMG_3719_Waneta Dam.jpg	4/29/2010 12:28
20100429	IMG_3720_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:28
20100429	IMG_3721_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:28
20100429	IMG_3722_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:29
20100429	IMG_3723_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:30
20100429	IMG_3724_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:32
20100429	IMG_3725_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:32
20100429	IMG_3726_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:32
20100429	IMG_3727_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:32
20100429	IMG_3728_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:32
20100429	IMG_3729_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:32
20100429	IMG_3730_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:32
20100429	IMG_3731_Pend Oreille below Waneta Dam.jpg	4/29/2010 12:32
20100429	IMG_3732-Waneta Reservoir above Dam.jpg	4/29/2010 12:43
20100429	IMG_3733-Waneta Reservoir above Dam.jpg	4/29/2010 12:43
20100429	IMG_3734-Waneta Reservoir above Dam.jpg	4/29/2010 12:43
20100429	IMG_3735-Waneta Reservoir-note turbulent flow.jpg	4/29/2010 12:52
20100429	IMG_3736-Waneta Reservoir.jpg	4/29/2010 12:53
20100429	IMG_3737-Waneta Reservoir.jpg	4/29/2010 12:53
20100429	IMG_3738-Waneta Reservoir above Dam.jpg	4/29/2010 12:53
20100429	IMG_3739-Seven Mile Dam.jpg	4/29/2010 12:55
20100429	IMG_3740-Seven Mile Dam.jpg	4/29/2010 12:56

FOLDER	FILE NAME	DATE/TIME (MST)
20100429	IMG_3741-Seven Mile Dam.jpg	4/29/2010 12:57
20100429	IMG_3742-Falls above Seven Mile Dam.jpg	1/17/2011 12:13
20100429	IMG_3743-Falls above Seven Mile Dam.jpg	1/17/2011 12:13
20100429	IMG_3744-Salmo River Tailings Deposit - Bear Tracks.jpg	1/17/2011 12:15
20100429	IMG_3745-Salmo River Tailings Deposit.jpg	4/29/2010 13:34
20100429	IMG_3746-Salmo River Tailings Deposit.jpg	4/29/2010 13:34
20100429	IMG_3747-Salmo River Tailings Deposit.jpg	4/29/2010 13:34
20100429	IMG_3748-Salmo River Tailings Deposit.jpg	4/29/2010 13:34
20100429	IMG_3749-Salmo River Tailings Deposit.jpg	4/29/2010 13:42
20100429	IMG_3750-Salmo River Tailings Deposit.jpg	4/29/2010 13:42
20100429	IMG_3751-Salmo River Tailings Deposit.jpg	4/29/2010 13:42
20100429	IMG_3752-Seven Mile Reservoir at ReMac.jpg	4/29/2010 13:46
20100429	IMG_3753-Seven Mile Reservoir at ReMac.jpg	4/29/2010 13:46
20100429	IMG_3754-Seven Mile Reservoir at ReMac.jpg	4/29/2010 13:46
20100429	IMG_3755-Seven Mile Reservoir at ReMac.jpg	4/29/2010 13:56
20100429	IMG_3756-Seven Mile Reservoir at ReMac.jpg	4/29/2010 13:56
20100429	IMG_3757-Seven Mile Reservoir at ReMac.jpg	4/29/2010 13:56
20100429	IMG_3758-Seven Mile Reservoir at ReMac.jpg	4/29/2010 13:56
20100429	IMG_3759-ReMac Mine.jpg	4/29/2010 14:00
20100429	IMG_3760-ReMac Mine.jpg	4/29/2010 14:00
20100429	IMG_3761-ReMac Mine.jpg	4/29/2010 14:00
20100429	IMG_3762-Power Line above ReMac.jpg	4/29/2010 14:08
20100429	IMG_3763-Pend Oreille Mine Tailings Pond.jpg	4/29/2010 14:42
20100429	IMG_3764-Pend Oreille Mine Tailings Pond.jpg	4/29/2010 14:42
20100429	IMG_3765-Pend Oreille Mine Tailings Pond.jpg	4/29/2010 14:42
20100429	IMG_3766-Pend Oreille Mine Tailings Pond.jpg	4/29/2010 14:42
20100429	IMG_3767-Pend Oreille Mine Tailings Pond.jpg	4/29/2010 14:42
20100429	IMG_3768-Pend Oreille Mine Tailings Pond.jpg	4/29/2010 14:42
20100429	IMG_3769-Grandview Mill.jpg	4/29/2010 14:49
20100429	IMG_3770-Grandview Mill.jpg	4/29/2010 14:49
20100429	IMG_3771-Grandview Mill.jpg	4/29/2010 14:49
20100429	IMG_3772-Grandview Mill.jpg	4/29/2010 14:57
20100429	IMG_3773-Grandview Mill.jpg	1/17/2011 12:37
20100429	IMG_3774-Grandview Mill.jpg	1/17/2011 12:37
20100429	IMG_3775-Grandview Tails.jpg	4/29/2010 15:01
20100429	IMG_3776-Grandview Tails.jpg	4/29/2010 15:01
20100429	IMG_3777-Grandview Tails.jpg	4/29/2010 15:01
20100429	IMG_3778-Grandview Tails.jpg	4/29/2010 15:06
20100429	IMG_3779-Grandview Tails.jpg	1/17/2011 12:37
20100429	IMG_3780-Grandview Tails.jpg	1/17/2011 12:37
20100429	IMG_3781-Grandview Tails.jpg	4/29/2010 15:10
20100429	IMG_3782-Sierra Zinc.jpg	4/29/2010 16:55
20100429	IMG_3783-Sierra Zinc.jpg	4/29/2010 16:55
20100429	IMG_3784-Sierra Zinc.jpg	4/29/2010 16:55
20100429	IMG_3785-Sierra Zinc.jpg	4/29/2010 16:55
20100429	IMG_3786-Sierra Zinc.jpg	4/29/2010 16:55
20100429	IMG_3787-Sierra Zinc.jpg	4/29/2010 16:55
20100429	IMG_3788-Sierra Zinc.jpg	4/29/2010 16:55
20100429	IMG_3789-Sierra Zinc.jpg	4/29/2010 16:55
20100429	IMG_3790-Sierra Zinc.jpg	4/29/2010 16:56
20100429	IMG_3791-Sierra Zinc.jpg	4/29/2010 16:56
20100429	IMG_3792-Sierra Zinc.jpg	4/29/2010 16:59
20100429	IMG_3793-Sierra Zinc.jpg	4/29/2010 17:05

FOLDER	FILE NAME	DATE/TIME (MST)
20100429	IMG_3794-Sierra Zinc.jpg	4/29/2010 17:05
20100429	IMG_3795-Sierra Zinc.jpg	4/29/2010 17:05
20100429	IMG_3796-Sierra Zinc.jpg	4/29/2010 17:05
20100429	IMG_3797-Sierra Zinc.jpg	4/29/2010 17:05
20100429	IMG_3798-Sierra Zinc.jpg	4/29/2010 17:05
20100429	IMG_3799-Sierra Zinc.jpg	1/18/2011 3:31
20100429	IMG_3800-Sierra Zinc.jpg	1/18/2011 3:31
20100429	IMG_3801-Sierra Zinc.jpg	4/29/2010 17:13
20100429	IMG_3802-Sierra Zinc.jpg	1/18/2011 3:31
20100429	IMG_3803-Sierra Zinc.jpg	1/18/2011 3:31
20100429	IMG_3804-Sierra Zinc.jpg	4/29/2010 17:21
20100429	IMG_3805-Sierra Zinc.jpg	4/29/2010 17:21
20100429	IMG_3806-Sierra Zinc.jpg	4/29/2010 17:21
20100429	IMG_3807-Sierra Zinc.jpg	4/29/2010 17:22
20100429	IMG_3808-Sierra Zinc.jpg	4/29/2010 17:22
20100429	IMG_3809-Sierra Zinc.jpg	4/29/2010 17:22
20100429	IMG_3810-Sierra Zinc.jpg	4/29/2010 17:22
20100429	IMG_3811-Sierra Zinc.jpg	4/29/2010 17:22
20100429	IMG_3812-Sierra Zinc.jpg	4/29/2010 17:29
20100429	IMG_3813-Sierra Zinc.jpg	4/29/2010 17:29
20100429	IMG_3814-Sierra Zinc.jpg	1/18/2011 3:33
20100429	IMG_3815-Sierra Zinc.jpg	4/29/2010 17:32
20100429	IMG_3816-Sierra Zinc.jpg	4/29/2010 17:32
20100429	IMG_3817-Sierra Zinc.jpg	4/29/2010 17:32
20100429	IMG_3818-Sierra Zinc.jpg	4/29/2010 17:33
20100429	IMG_3819-Deep Creek Mine.jpg	4/29/2010 17:53
20100429	IMG_3820-Deep Creek Mine.jpg	4/29/2010 17:53
20100429	IMG_3821-Deep Creek Mine.jpg	4/29/2010 17:53
20100429	IMG_3822--Deep Creek Mine.jpg	4/29/2010 17:53
20100429	IMG_3823-Deep Creek Mine.jpg	4/29/2010 17:53
20100429	IMG_3824-Deep Creek Mine.jpg	4/29/2010 17:53
20100429	IMG_3825-Deep Lake.jpg	4/29/2010 18:06
20100429	IMG_3826-Deep Lake.jpg	4/29/2010 18:06
20100429	IMG_3827-Deep Lake.jpg	4/29/2010 18:07
20100429	IMG_3828-Deep Lake.jpg	4/29/2010 18:07
20100429	IMG_3829-Anderson-Calhoun.jpg	4/29/2010 18:26
20100429	IMG_3830-Anderson-Calhoun.jpg	4/29/2010 18:27
20100429	IMG_3831-Anderson-Calhoun.jpg	4/29/2010 18:27
20100429	IMG_3832-Anderson-Calhoun.jpg	4/29/2010 18:27
20100429	IMG_3833-Anderson-Calhoun.jpg	4/29/2010 18:27
20100429	IMG_3834-Anderson-Calhoun.jpg	4/29/2010 18:27
20100429	IMG_3835-Anderson-Calhoun.jpg	4/29/2010 18:27
20100429	IMG_3836-Anderson-Calhoun.jpg	4/29/2010 18:27
20100429	IMG_3837-Anderson-Calhoun.jpg	4/29/2010 18:27
20100429	IMG_3838-Anderson-Calhoun.jpg	4/29/2010 18:29
20100429	IMG_3839-Anderson-Calhoun.jpg	4/29/2010 18:36
20100429	IMG_3840-Anderson-Calhoun.jpg	4/29/2010 18:36
20100429	IMG_3841-Anderson-Calhoun.jpg	4/29/2010 18:37
20100429	IMG_3842-Anderson-Calhoun.jpg	4/29/2010 18:37
20100429	IMG_3843-Anderson-Calhoun.jpg	4/29/2010 18:37
20100429	IMG_3844-Anderson-Calhoun.jpg	4/29/2010 18:38
20100429	IMG_3845-Anderson-Calhoun.jpg	4/29/2010 18:49
20100429	IMG_3846-Anderson-Calhoun.jpg	4/29/2010 18:50

FOLDER	FILE NAME	DATE/TIME (MST)
20100429	IMG_3847-Black Sand Beach.jpg	4/29/2010 19:12
20100429	IMG_3848-Black Sand Beach.jpg	4/29/2010 19:13
20100429	IMG_3849-Black Sand Beach.jpg	4/29/2010 19:13

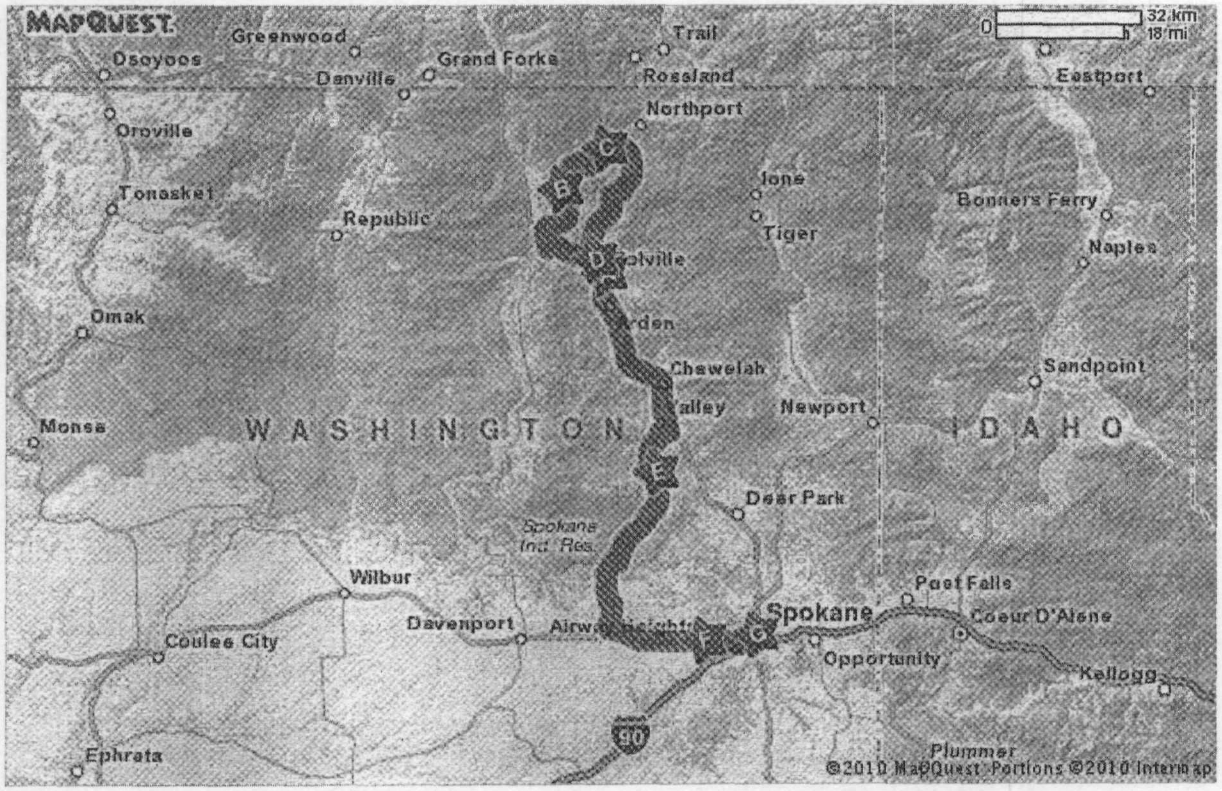
MAPQUEST.

Notes

Trip to Spokane, WA

157.60 miles - about 3 hours 22 minutes

Route Map Hide



 | Map Legend

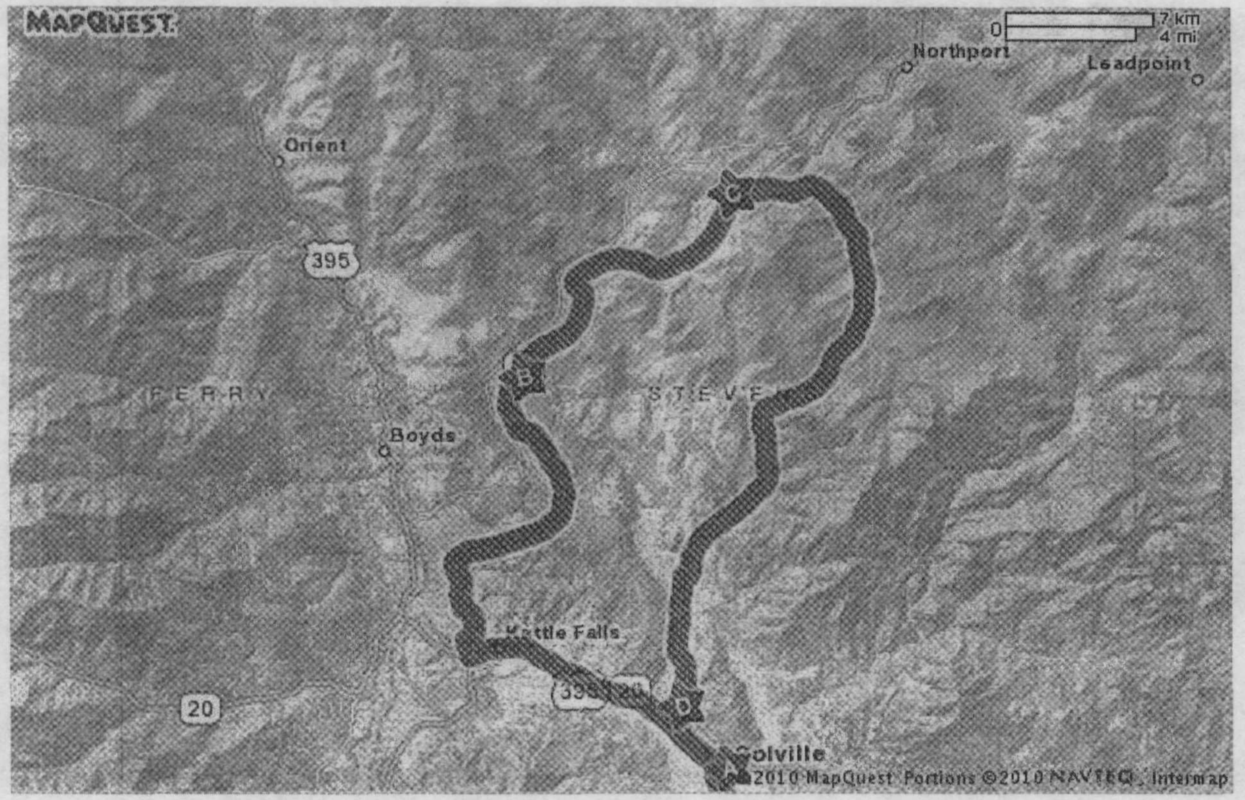
MAPQUEST.

Trip to Spokane, WA

157.60 miles - about 3 hours 22 minutes

Notes

Route Map Hide



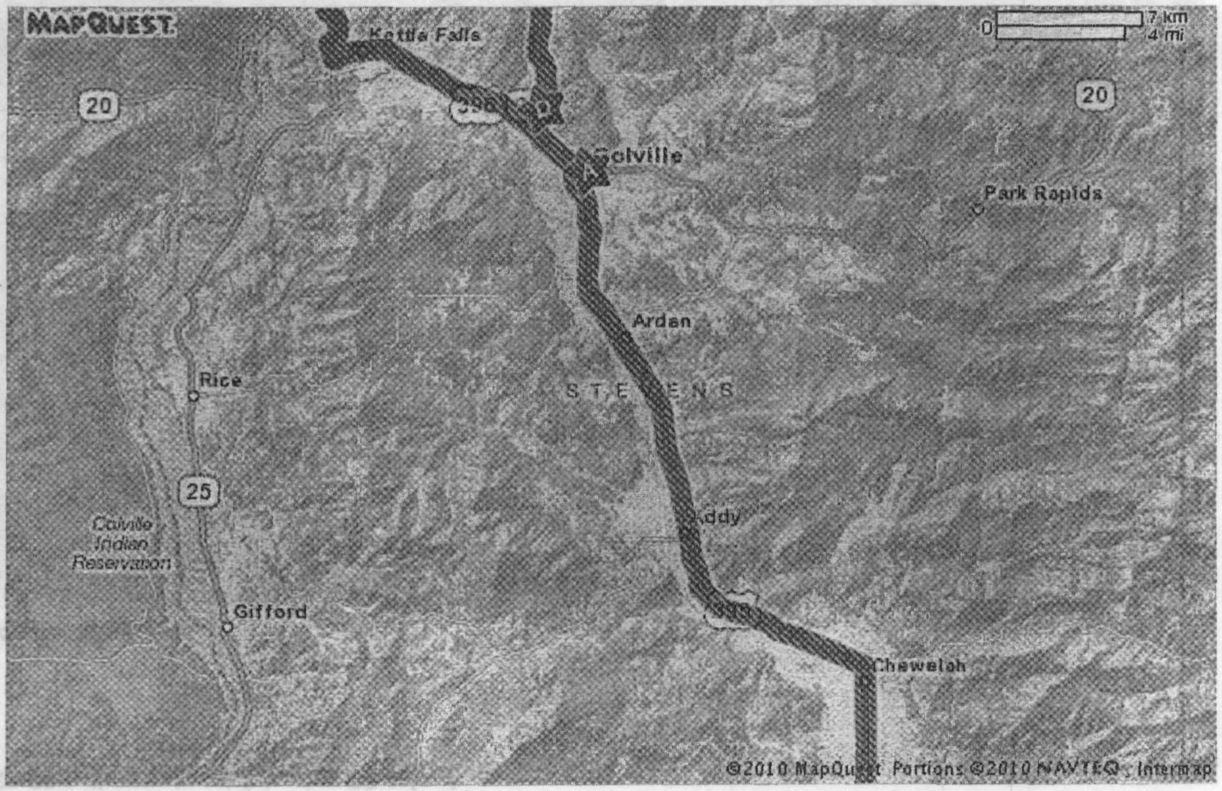
MAPQUEST.

Notes

Trip to Spokane, WA

157.60 miles - about 3 hours 22 minutes

Route Map Hide



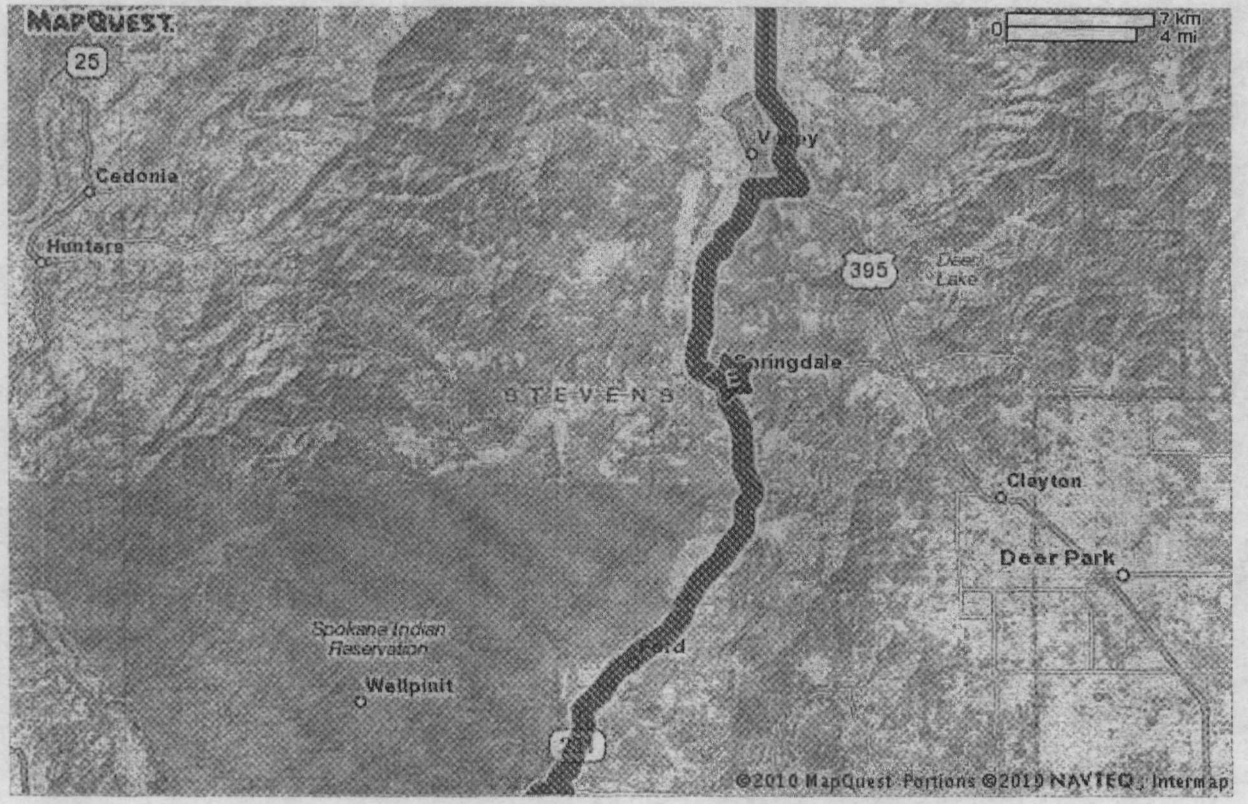
MAPQUEST.

Notes

Trip to Spokane, WA

157.60 miles - about 3 hours 22 minutes

Route Map Hide



 | Map Legend

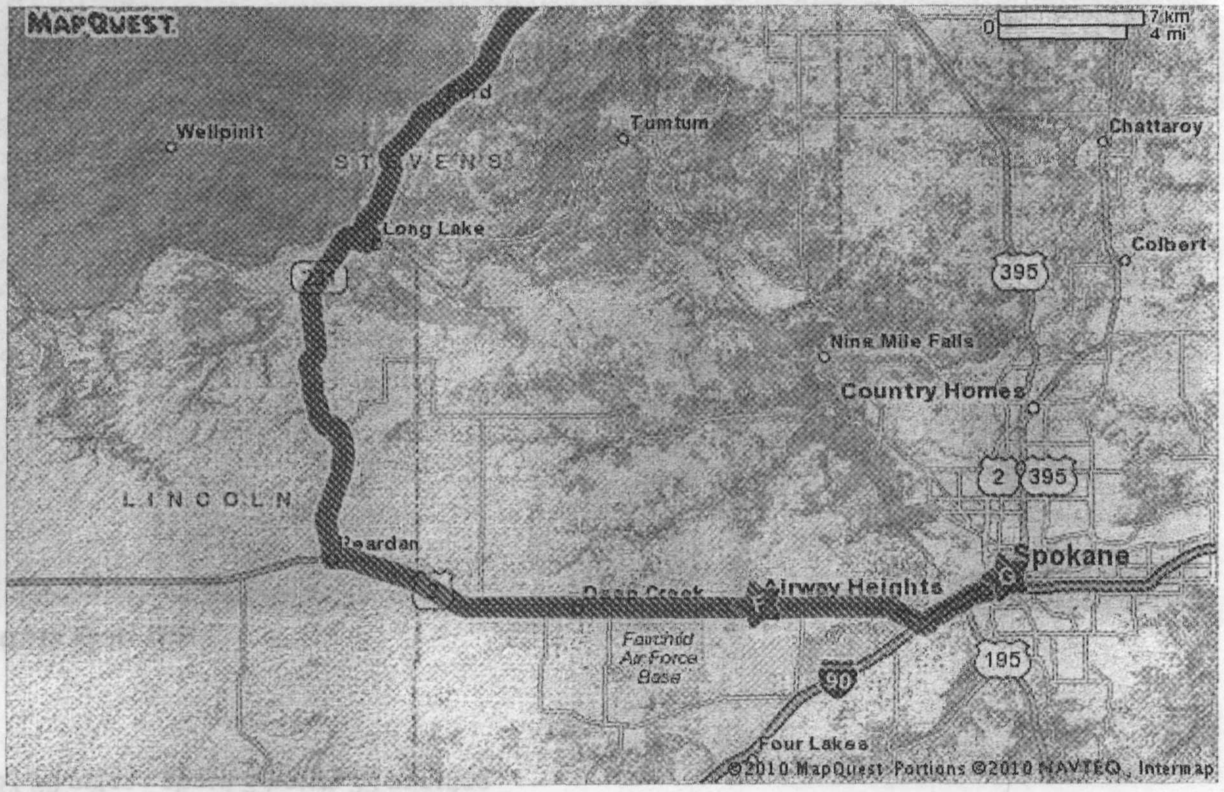
MAPQUEST.

Notes

Trip to Spokane, WA

157.60 miles - about 3 hours 22 minutes

Route Map Hide



 | Map Legend

FOLDER	FILE NAME	DATE/TIME (MST)
20100430	1615A_20100430_AB_Bonanza Mill.jpg	1/18/2011 6:23
20100430	1615A_20100430_AB_Bonanza Mine.jpg	1/18/2011 4:58
20100430	1615A_20100430_AB_Bonanza Mine-1.jpg	1/18/2011 5:08
20100430	1615A_20100430_AB_Bonanza Mine-2.jpg	1/18/2011 5:12
20100430	1615A_20100430_AB_Bonanza Mine-3-Sinkhole.jpg.jpg	1/18/2011 5:16
20100430	1615A_20100430_AB_Bonanza Mine-4-Revegetation.jpg	1/18/2011 5:18
20100430	1615A_20100430_AB_Bonanza Mine-5-Waste Pile.jpg	1/18/2011 5:20
20100430	1615A_20100430_AB_Bonanza Mine-6-Revegetation.jpg	1/18/2011 5:21
20100430	1615A_20100430_AB_Northport.jpg	1/18/2011 5:28
20100430	1615A_20100430_AB_Northport-Beach.jpg	1/18/2011 5:30
20100430	1615A_20100430_AB_Northport-Beach-1.jpg	1/18/2011 5:38
20100430	1615A_20100430_AB_Van Stone-Lower Tails.jpg	1/18/2011 5:44
20100430	1615A_20100430_AB_Van Stone-Lower Tails-1.jpg	1/18/2011 5:45
20100430	1615A_20100430_AB_Van Stone-Lower Tails-2.jpg	1/18/2011 5:48
20100430	1615A_20100430_AB_Van Stone-Lower Tails-3.jpg	1/18/2011 5:50
20100430	1615A_20100430_AB_Van Stone-Lower Tails-4.jpg	1/18/2011 5:53
20100430	1615A_20100430_AB_Van Stone-Lower Tails-5-Washout.jpg	1/18/2011 5:56
20100430	1615A_20100430_AB_Van Stone-Mil-1l.jpg	1/18/2011 6:13
20100430	1615A_20100430_AB_Van Stone-Mill.jpg	1/18/2011 6:11
20100430	1615A_20100430_AB_Van Stone-Mine-2.jpg	1/18/2011 6:09
20100430	1615A_20100430_AB_Van Stone-Waste Pile.jpg	1/18/2011 5:59
20100430	1615A_20100430_AB_Van Stone-Waste Pile-Mine.jpg	1/18/2011 6:02
20100430	1615A_20100430_AB_Van Stone-Waste Pile-Mine-1.jpg	1/18/2011 6:06
20100430	1615A-20100430_AB_Kettle Falls Pano.jpg	1/18/2011 4:50
20100430	IMG_3850-Well Driller Sign.jpg	4/30/2010 7:26
20100430	IMG_3851-Well Driller Sign.jpg	4/30/2010 7:26
20100430	IMG_3852-Well Driller Sign.jpg	4/30/2010 7:26
20100430	IMG_3853-Well Driller Sign.jpg	4/30/2010 7:26
20100430	IMG_3854-Kettle Falls.jpg	4/30/2010 8:04
20100430	IMG_3855-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:04
20100430	IMG_3856-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:04
20100430	IMG_3857-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:04
20100430	IMG_3858-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:04
20100430	IMG_3859-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:04
20100430	IMG_3860-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:04
20100430	IMG_3861-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:04
20100430	IMG_3862-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:05
20100430	IMG_3863-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:06
20100430	IMG_3864-Lake Roosevelt-Kettle Falls.jpg	4/30/2010 8:06
20100430	IMG_3865-Road slope blasting.jpg	4/30/2010 8:11
20100430	IMG_3866-Road slope blasting.jpg	4/30/2010 8:11
20100430	IMG_3867_Bonanza Mine.jpg	4/30/2010 8:34
20100430	IMG_3868_Bonanza Mine.jpg	4/30/2010 8:34
20100430	IMG_3869_Bonanza Mine.jpg	4/30/2010 8:34
20100430	IMG_3870_Bonanza Mine.jpg	4/30/2010 8:34
20100430	IMG_3871_Bonanza Mine.jpg	4/30/2010 8:34
20100430	IMG_3872_Bonanza Mine.jpg	1/18/2011 4:59
20100430	IMG_3873_Bonanza Mine.jpg	1/18/2011 5:00
20100430	IMG_3874_Bonanza Mine.jpg	1/18/2011 5:00
20100430	IMG_3875_Bonanza Mine.jpg	1/18/2011 5:00
20100430	IMG_3876_Bonanza Mine.jpg	1/18/2011 5:00
20100430	IMG_3877_Bonanza Mine.jpg	1/18/2011 5:00
20100430	IMG_3878_Bonanza Mine.jpg	1/18/2011 5:00

FOLDER	FILE NAME	DATE/TIME (MST)
20100430	IMG_3879_Bonanza Mine.jpg	1/18/2011 5:00
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20100430	IMG_3881_Bonanza Mine.jpg	1/18/2011 5:00
20100430	IMG_3882_Bonanza Mine.jpg	1/18/2011 5:00
20100430	IMG_3883_Bonanza Mine.jpg	1/18/2011 5:00
20100430	IMG_3884_Bonanza Mine.jpg	1/18/2011 4:59
20100430	IMG_3885_Bonanza Mine.jpg	4/30/2010 8:52
20100430	IMG_3886_Bonanza Mine.jpg	4/30/2010 8:52
20100430	IMG_3887_Bonanza Mine.jpg	4/30/2010 8:52
20100430	IMG_3888_Bonanza Mine.jpg	4/30/2010 8:52
20100430	IMG_3889_Bonanza Mine.jpg	4/30/2010 8:52
20100430	IMG_3890_Bonanza Mine.jpg	4/30/2010 8:53
20100430	IMG_3891_Bonanza Mine.jpg	1/18/2011 5:10
20100430	IMG_3892_Bonanza Mine.jpg	1/18/2011 5:10
20100430	IMG_3893_Bonanza Mine.jpg	1/18/2011 5:10
20100430	IMG_3894_Bonanza Mine.jpg	4/30/2010 8:59
20100430	IMG_3895_Bonanza Mine.jpg	4/30/2010 9:00
20100430	IMG_3896_Bonanza Mine.jpg	4/30/2010 9:00
20100430	IMG_3897_Bonanza Mine.jpg	4/30/2010 9:00
20100430	IMG_3898_Bonanza Mine.jpg	4/30/2010 9:00
20100430	IMG_3899_Bonanza Mine.jpg	4/30/2010 9:00
20100430	IMG_3900_Bonanza Mine.jpg	4/30/2010 9:00
20100430	IMG_3901_Bonanza Mine.jpg	4/30/2010 9:01
20100430	IMG_3902_Bonanza Mine.jpg	1/18/2011 5:14
20100430	IMG_3903_Bonanza Mine.jpg	1/18/2011 5:14
20100430	IMG_3904_Bonanza Mine.jpg	1/18/2011 5:14
20100430	IMG_3905_Bonanza Mine.jpg	1/18/2011 5:14
20100430	IMG_3906_Bonanza Mine-Monitor Well.jpg	1/18/2011 5:14
20100430	IMG_3907-Northport Smelter.jpg	4/30/2010 9:36
20100430	IMG_3908-Northport Smelter.jpg	4/30/2010 9:36
20100430	IMG_3909-Northport Smelter.jpg	4/30/2010 9:36
20100430	IMG_3910-Northport Smelter.jpg	4/30/2010 9:36
20100430	IMG_3911-Northport Smelter.jpg	4/30/2010 9:36
20100430	IMG_3912-Northport Smelter.jpg	4/30/2010 9:36
20100430	IMG_3913-Northport Smelter.jpg	4/30/2010 9:36
20100430	IMG_3914-Northport Smelter.jpg	4/30/2010 9:36
20100430	IMG_3915-Northport Smelter.jpg	4/30/2010 9:37
20100430	IMG_3916-Northport Smelter.jpg	4/30/2010 9:37
20100430	IMG_3917-Northport Beach.jpg	4/30/2010 10:02
20100430	IMG_3918-Northport Beach.jpg	4/30/2010 10:05
20100430	IMG_3919-Northport Beach.jpg	4/30/2010 10:12
20100430	IMG_3920-Northport Beach.jpg	4/30/2010 10:19
20100430	IMG_3921-Northport Beach.jpg	4/30/2010 10:19
20100430	IMG_3922-Northport Beach.jpg	4/30/2010 10:19
20100430	IMG_3923-Northport Beach.jpg	1/18/2011 5:34
20100430	IMG_3924-Northport Beach.jpg	4/30/2010 10:26
20100430	IMG_3925-Northport Beach.jpg	4/30/2010 10:26
20100430	IMG_3926-Northport Beach.jpg	4/30/2010 10:30
20100430	IMG_3927-Northport Beach.jpg	4/30/2010 10:30
20100430	IMG_3928-Northport Beach.jpg	4/30/2010 10:30
20100430	IMG_3929-Northport Beach.jpg	4/30/2010 10:30
20100430	IMG_3930-Northport Beach.jpg	4/30/2010 10:30
20100430	IMG_3931-Northport Beach.jpg	4/30/2010 10:31

FOLDER	FILE NAME	DATE/TIME (MST)
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20100430	IMG_3934-Northport Beach.jpg	4/30/2010 10:31
20100430	IMG_3935-Northport Beach.jpg	4/30/2010 10:41
20100430	IMG_3936-Northport Beach.jpg	4/30/2010 10:41
20100430	IMG_3937-Van Stone-Lower Tails.jpg	4/30/2010 11:22
20100430	IMG_3938-Van Stone-Lower Tails.jpg	4/30/2010 11:22
20100430	IMG_3939-Van Stone-Lower Tails.jpg	4/30/2010 11:22
20100430	IMG_3940-Van Stone-Lower Tails.jpg	4/30/2010 11:22
20100430	IMG_3941-Van Stone-Lower Tails.jpg	4/30/2010 11:22
20100430	IMG_3942-Van Stone-Lower Tails.jpg	4/30/2010 11:22
20100430	IMG_3943-Van Stone-Lower Tails.jpg	4/30/2010 11:22
20100430	IMG_3944-Van Stone-Lower Tails.jpg	4/30/2010 11:22
20100430	IMG_3945-Van Stone-Lower Tails.jpg	4/30/2010 11:27
20100430	IMG_3946-Van Stone-Lower Tails.jpg	4/30/2010 11:27
20100430	IMG_3947-Van Stone-Lower Tails.jpg	4/30/2010 11:27
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20100430	IMG_4018-Bonanza Mill.jpg	4/30/2010 14:09
20100430	IMG_4019-Bonanza Mill.jpg	4/30/2010 14:09
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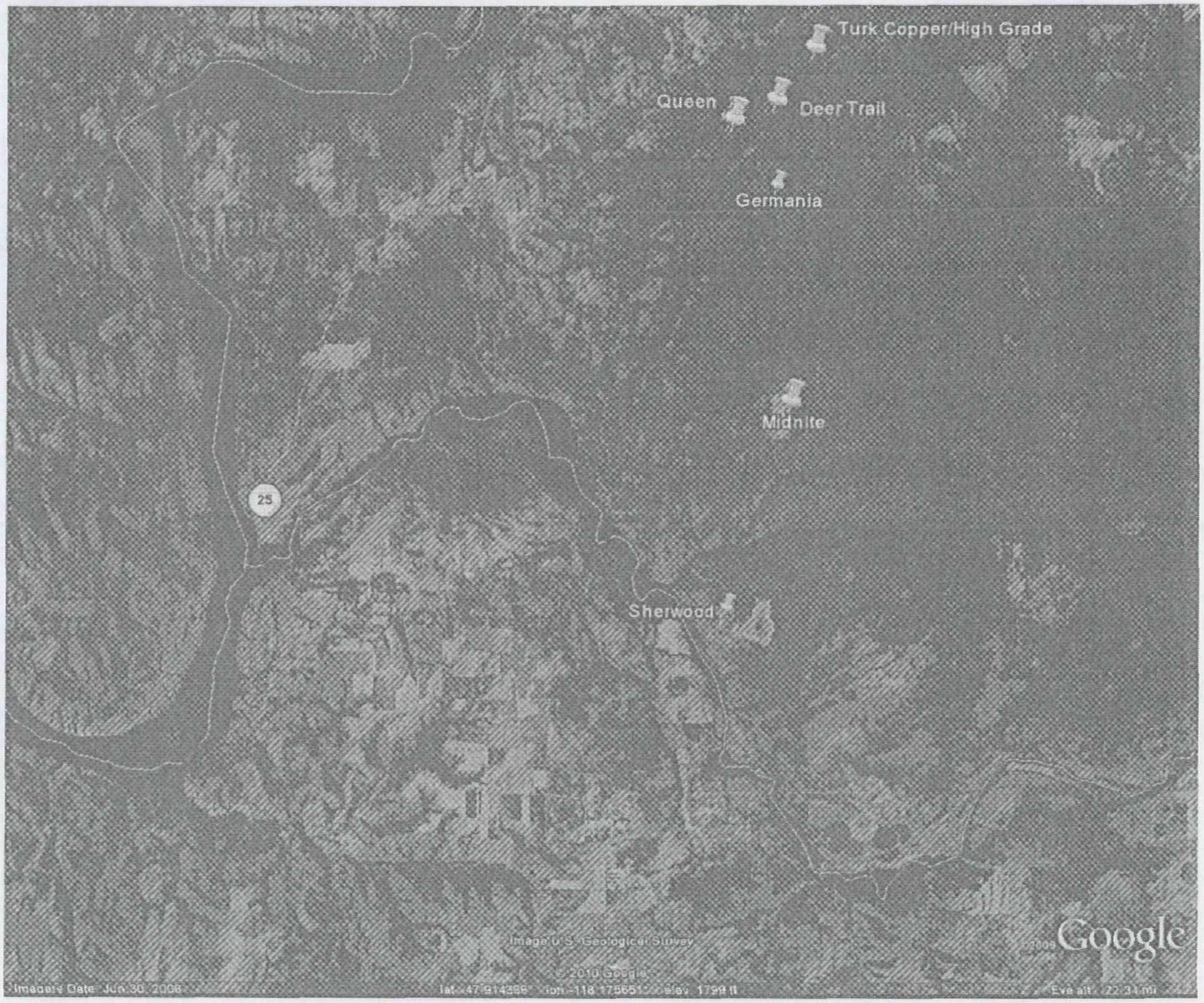
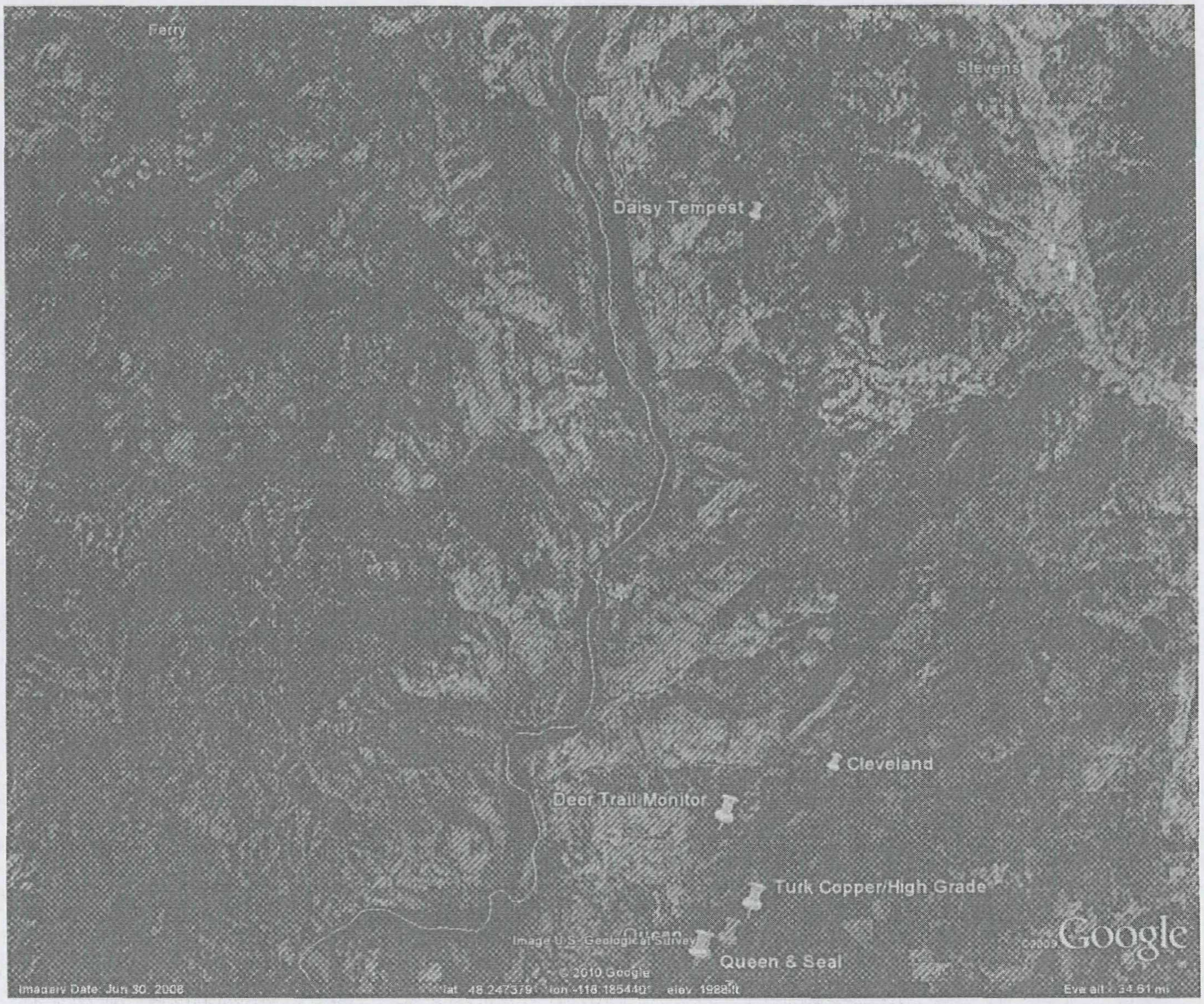
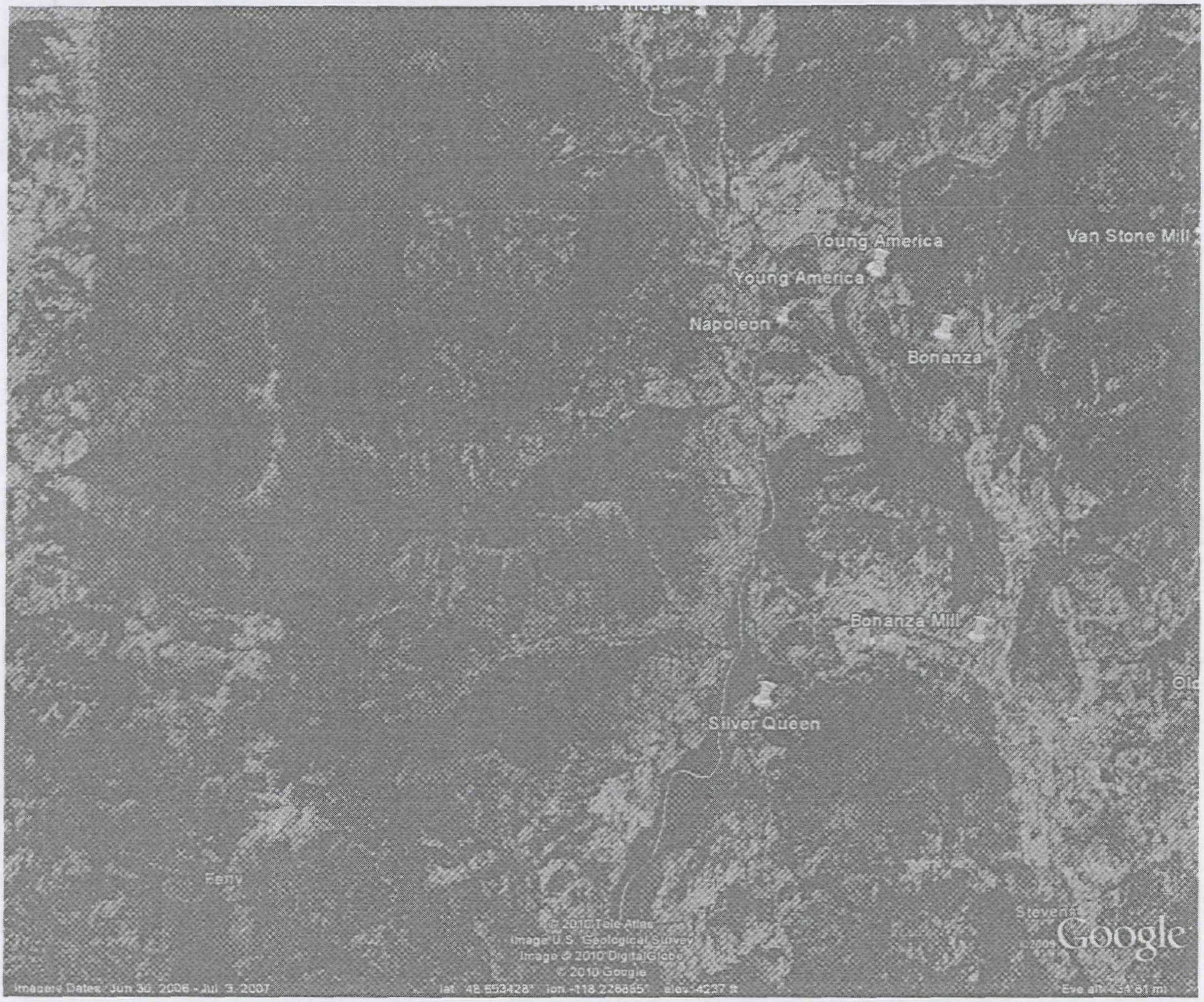


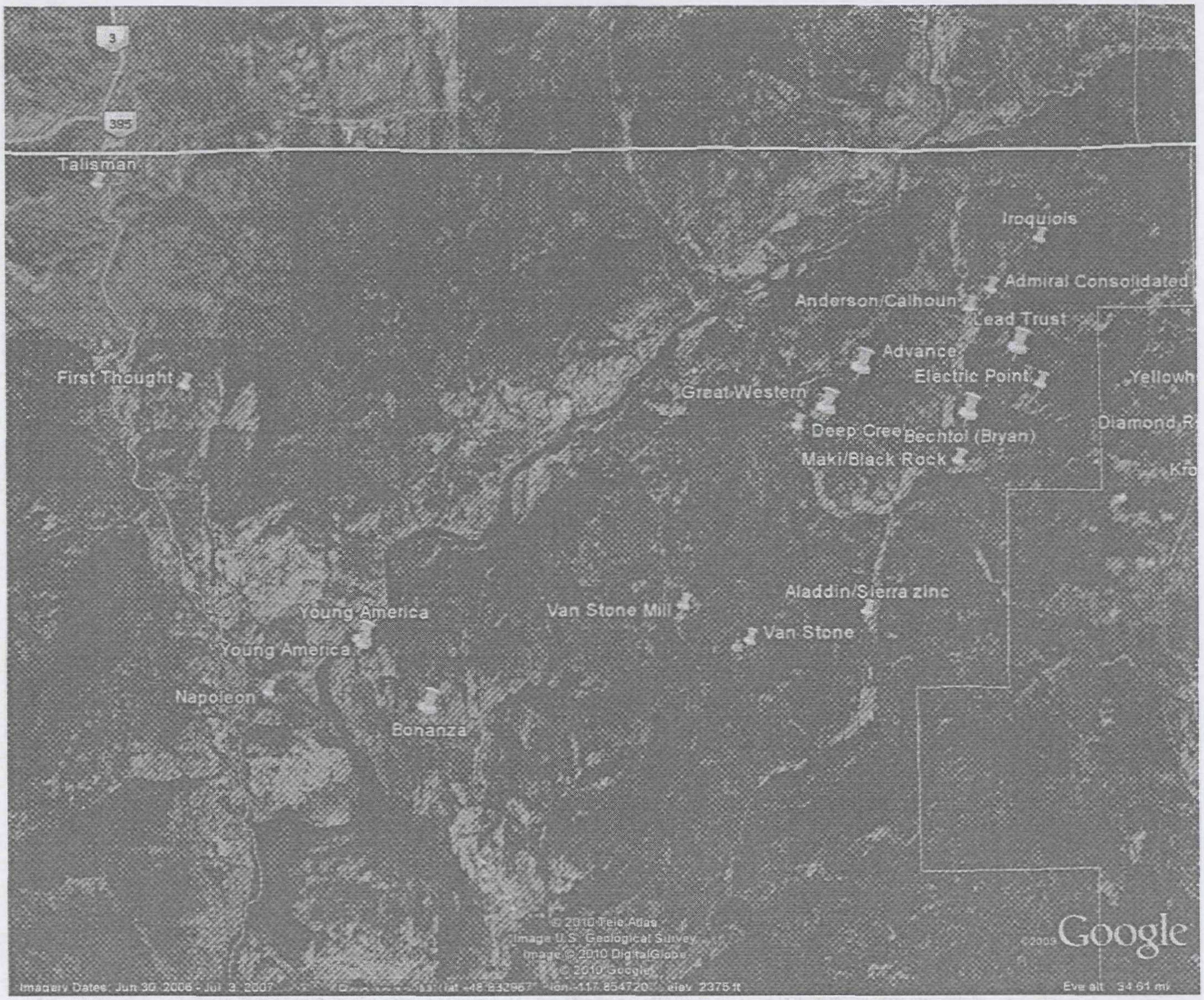
Spokane River and Rez



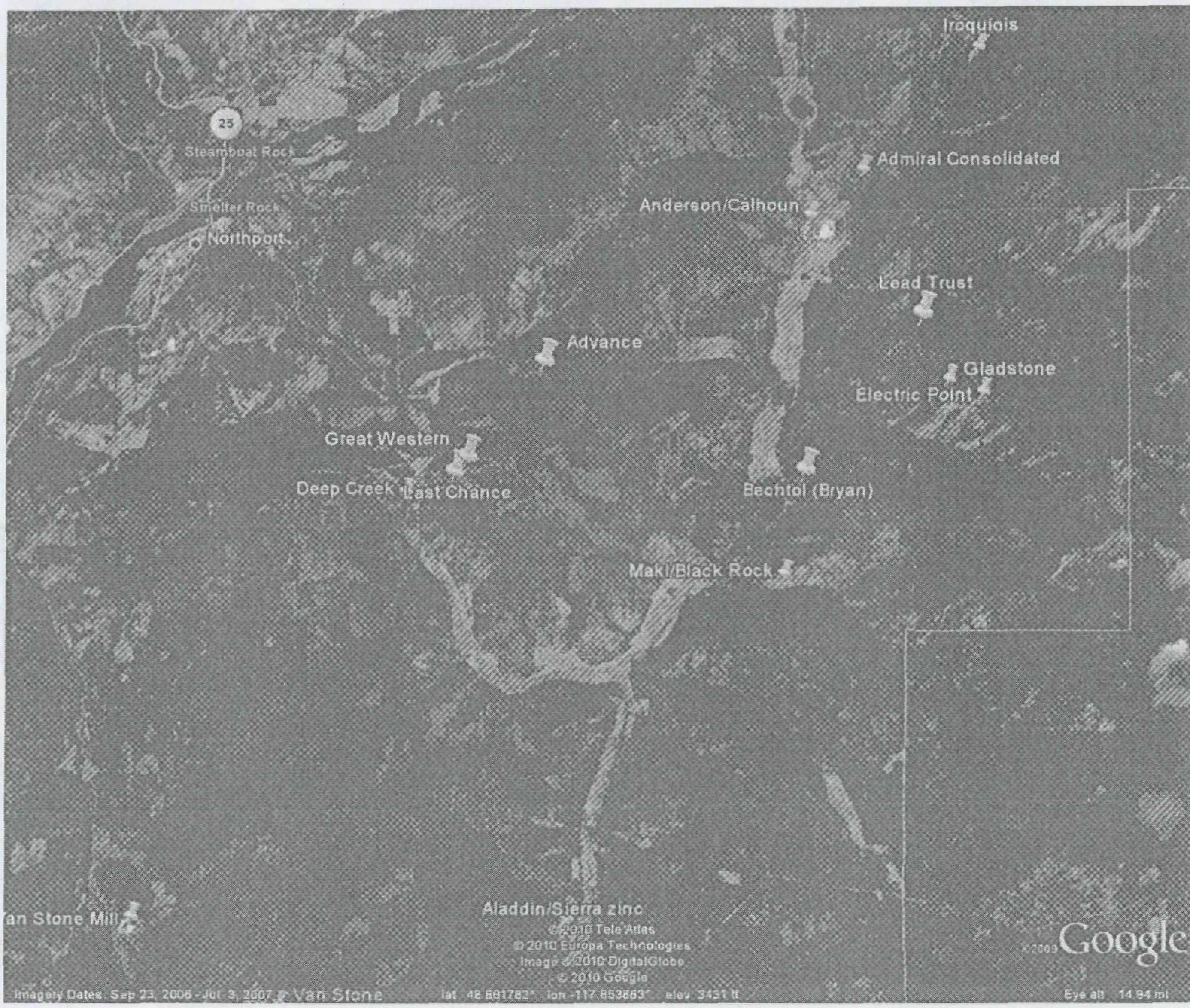
Deer Trail and East Bank UCR towards Kettle Falls



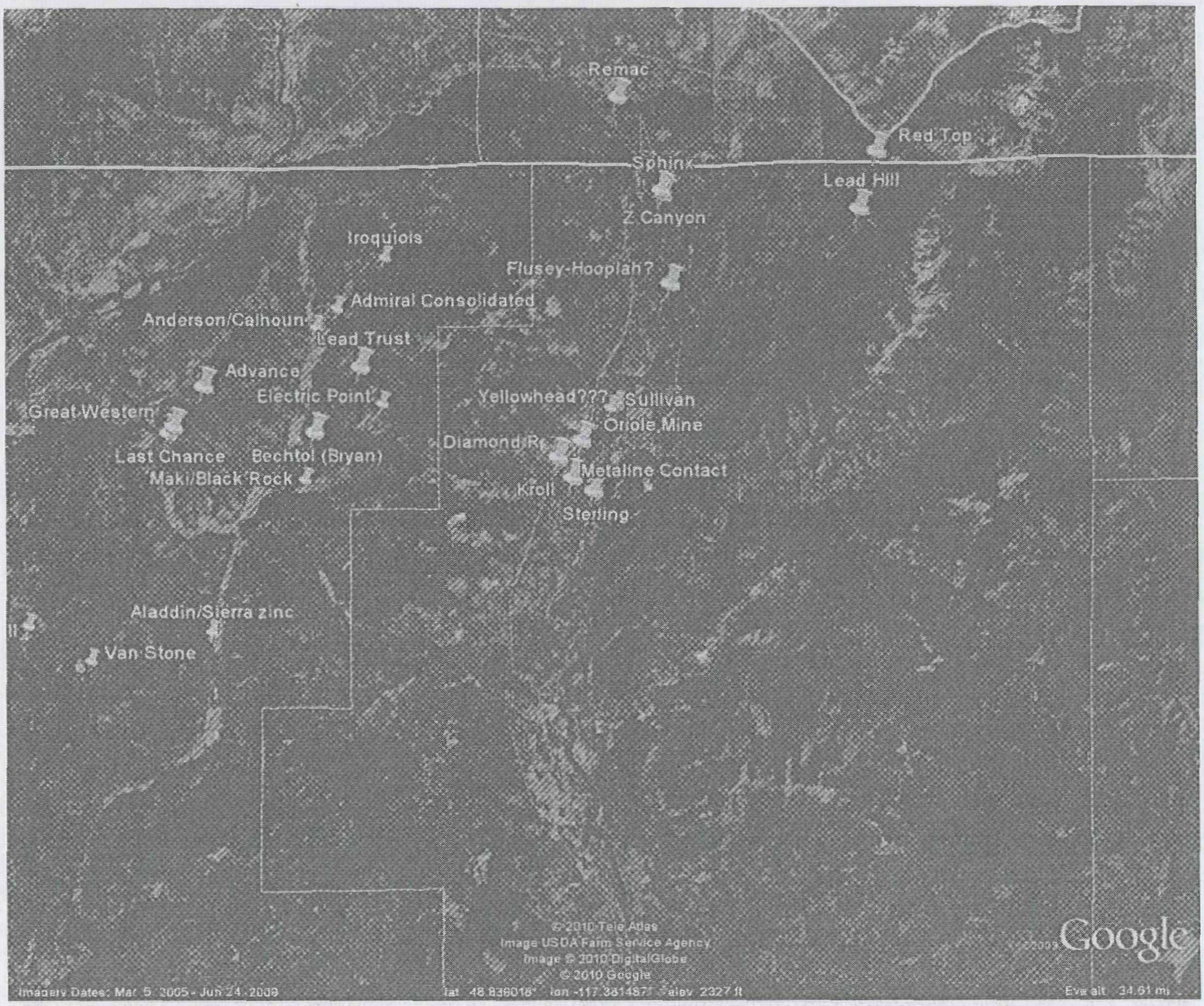
Kettle Falls and Marcus Flats/Bossburg area



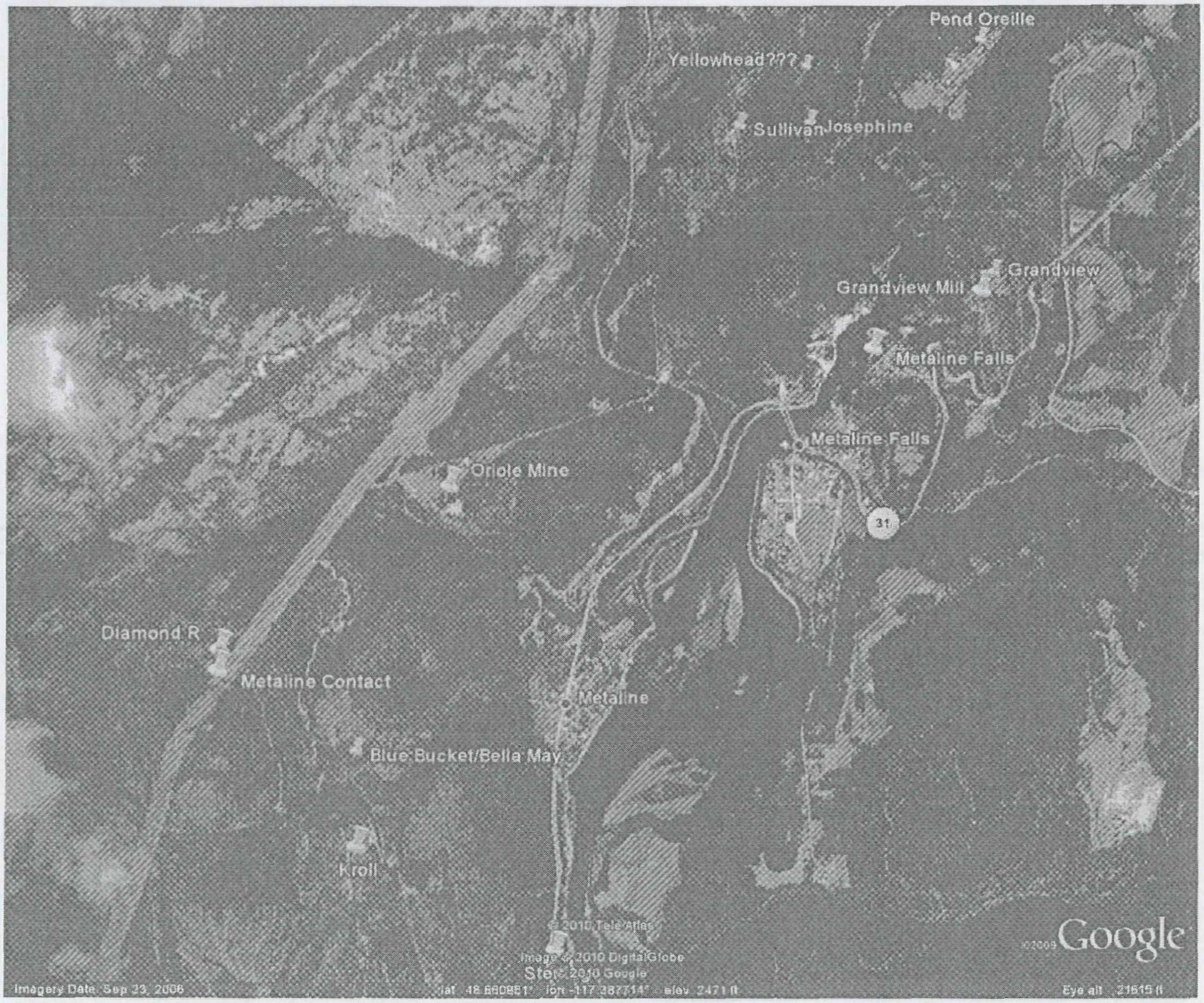
Deep Creek - Northport -Orient areas



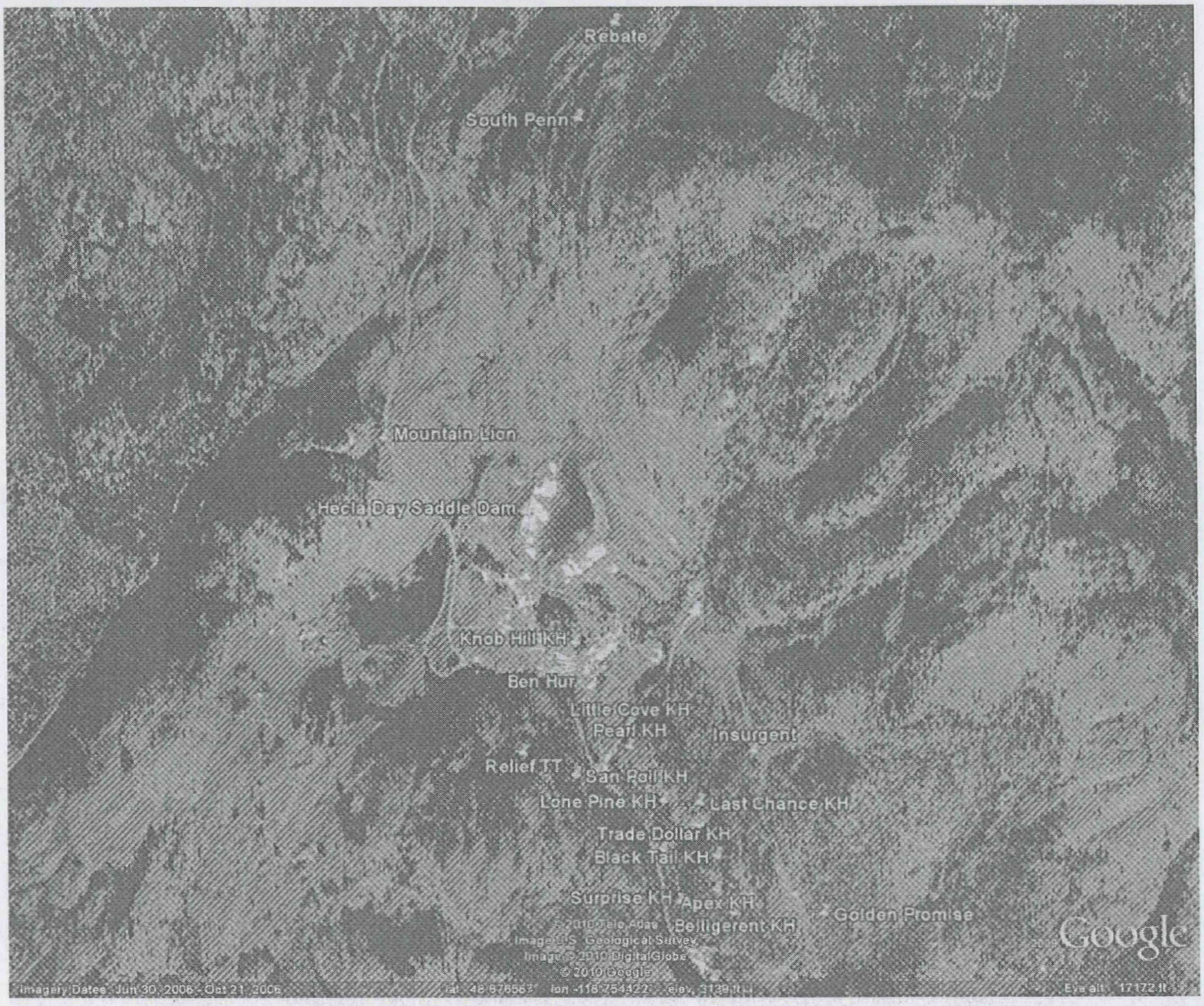
Deep Creek Closeup



Deep Creek - Metaline areas



Metaline Closeup



North Republic/ Eureka Gulch Closeup

ATTACHMENT 2

FIELD NOTES

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AdrianBrown

Groundwater Hydrology • Geochemistry • Remediation

PROJECT TITLE: PAKOOTAS V TECK

PROJECT LOCATION: UCR

PROJECT#/MGR: BROWN

DATE: APRIL 28, 2010

FIELD BOOK: 1 of ______

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"Innovative Environmental Solutions"

4/28/10

0745 LEAVE SPOKANE
DRIVE TO SPOKANE RIVER/
COLUMBIA RIVER CONFLUENCE

3622-26 PANO FROM N → W OF
SPOKANE R @ BRIDGE

HAND SAMPLE TAKEN @ SEDIMENT
ON BANK

(1) ROUNDED SANDS / BASALT ~50%

27-28 LOOKING UPSTREAM ON SPOKANE R

[illegible] AB NOTE TERRACING / MAJOR LANDSLIDE
ON NORTH BANK JUST OUT OF
SHOT UPSTREAM (SEEN FROM
RIVER IN CAR)

11:15 CLIFFORD FERRY
(2) SAMPLE OF SAND FROM BANK
[illegible] AB ~30' BELOW TOP WATER LEVEL
UNDER 30x MAGNIFICATION DOES
NOT CONTAIN FACETED MATERIAL

11:52 COLVILLE RIVER CONFLUENCE
(3) FINE AEOLIAN MATERIAL

30-31 UPSTREAM TO COLVILLE
NOTE COBBLES EXPOSED BY
WAVE ACTION

BOB WEAVER
MARK ELLIS
SANDY REESE
MARK JOHNS, EXPONENT
GREG DAVIS, BROWN & CALDWELL

AB 4/28/10

4/28/10 OCR

12:15 COLVILLE RIVER
HYDRO @ MEYERS FALLS
NOTE TURBIDITY / TAN WATER
DAM FROM 1866 (SMALL)
HYDRO SYSTEM 1890'S
CURRENT HYDRO @ 1915
WASH WATER POWER TO 1990S
33-46 NOW PRIVATE
FLOW >> HYDRO NEEDS
SUBSTANTIAL OVERFLOW
DURING VISIT
14:15 REPUBLIC DISTRICT
47-51 KNOB HILL MINE
PANO FROM N → SW
NOTE TAILINGS POND TO NORTH
MUD LAKE TO WEST
EVIDENCE OF TAILINGS BLOWOUT
FROM ~ EARLY 80'S
52-55 PANO FROM ABOVE MINE PORTAL
NOTE WASTE ROCK BENCH FOR
BUILDINGS & OXIDATION PRODUCTS
ON THE ROCK FACES
58-60 FROM ABOVE (KNOB HILL)
TAILINGS POND TO ~~LEFT~~ AT RIGHT

4/28/10 UCR

* MUD LAKE IN BACKGROUND (FULL?)
* TAILS OVER MINE?
* TAILS POND WET OVER N 1/2 SURFACE
*

14:45 CREEK RUNNING OUT OF KNOB
HILL - GRANITE CK TRIBUTARY
61-62 ④ SAMPLED & PHOTOGRAPH
SANDY ORGANIC MATERIAL
MODEST FLOW (~200 GPM)
15:00 INSPECT SAN POIL R BELOW REPUBLIC
63-72 FLOW UNDER BRIDGE ~3 MI
SOUTH OF REPUBLIC
NOTE TURBIDITY & HIGHLY
TURBULENT FLOW
BANK EROSION EVIDENT
DOWNSTREAM
STREAM MEANDERS, BUT
DOES NOT SLOW DOWN DUE
TO VERTICAL CUT BANKS
15:10 GRANITE CREEK AT CONFLUENCE
73 WITH SANPOIL
NOTE HIGH FLOW IN GROWTH BANKS
74 LOOKING U/S @ BEAVER DAMS
- STILL HIGH FLOW & XPORT

4/28/10 UCR

15:45 BESIDE KETTLE R
KZ MINE ON SOUTH
LARGE OPEN ROCK PILE
N OF RIVER - CHECK
75-76 KETTLE RIVER LOOKING D/S
& U/S @ BRIDGE. TURBULENT
& TURBID.
CANADA

17:00 BOUNDARY FALLS SMELTER
78-87 (SUNSET)
(1) SMALL - 1898-1910 ±
(2) GRANULATED AT EAST
LIQUID AT WEST

17:10 GREENWOOD SMELTER/ANACONDA
(5) RARE GRANULAR SLAG @ PILE
MOST IS SOLID
88-04 WATER GOES UNDER SLAG
IN ENGINEERED TUNNEL
SLAG CARRIER POTS ON
ENTIRE AREA

18:30 GRAND FORKS/GRANBY
PAND
05-12 APPEARS COMBINED
- MASS SLAG @ BASE
- GRANULAR @ TOP
GRANULAR BEING PROCESSED
& SHIPPED FOR ROCK WOOL (?)
(6) SAMPLED @ ROADSIDE PILE

4/28/10

4/29/10 TECK CONTINUED
JOHN HIGGINSON
ROB DROW - ENVIRONMENT

1897 (Cu)
1907 (Pb)
1914 (Zn)

SULLIVAN MINE → MAIN SOURCE
ZN CON → IRON
LEAD CON 220 KT/Y → 80 KT/Y
LEAD TREAT ~~[illegible]~~ KIVCET
SLAG
- TAIL SLAG
- BARREN SLAG / FERROUS GRANULES
- RETREATMENT SLAG (ZOS)
- "TREATMENT SLAG" ALSO
LIMESTONE & SILICA ADDED → SLAG FLUID.
CHLORINE & FLUORINE LEACH
ARSENIC & CD A PROBLEM
EFF TREAT
HI DENSITY SLUDGE TREAT
LIME
RUNNING 1930 / SHUTDOWN 93
2ND 1949 / 3RD

4/29/10 TECK VISIT

ROAST → LEACH EW MELT

PRESS LEACH BREWING

#6 SAMPLE

9:30 MERCURY TMT (DEGUSSA)
PH DEPENDENT
WTP → OUTFALL #3
100,000 m^3/D
1000 m^3/D CIP WATER

7.5 L/m FLOC @ 7500 L/m FLOW

ORGANICS
ANIMAL GLUE - LEVELING AGENT IN ZINC PLANT
LIGNOSOL - PRESS LEACH
LICORICE
FROTH AGENTS

4/29/10

10:00 RELEASE FROM WTP
SPRAY/HAMMOCK
SOLIDS ON UNPAVED AREA
SEEPAGE → BMW → RIVER
BILL JANKOLA

10:40 #4 DISCHARGE @CREEK
24,000 m^3/D FROM WARFIELD
(FERTILIZER)
#3 CENTRAL PLANT & ETP (10%)
ZINC OPS
#2 FROM ~~WEST~~ EAST ZINC OPS &
STORMWATER

LANDED WOULD DISCHARGE
TO RIVER Ō SLAG & ALSO
1995 DECOMMISSIONED

11:30 WARFIELD
WIDE RANGE OF ACTIONS

Fe → SLAG

S → H_2SO_4
→ FERTIZER
→ SO_2 LIQUID

GYPSUM → RIVER
1930s → 1994
MERCURY ASSOCIATED WITH
WARM SPRINGS MONTANA
PHOSPHATE ROCK.
BERNAL MINE

AB 4/29/10

4/29/10 UCR

13:00 VISIT TO WANETA DAM

3718-23 TURBIDITY HIGH BELOW DAM

POND D/S OF WANETA –

JUNCTION OF UCR &

24-31 WANETA DAM CATCHMENT

DAM IS FULL NO SPILL,

WHICH IS SURPRISING FOR

HIGH FLOW CONDITIONS

WATER TURBULENT WELL UPSTREAM

39-41 SEVEN MILE DAM

ALSO NOT SPILLING, NEAR FULL

WATER IS TURBID.

LOWER TURBULENCE AS

THE DAM IS HIGHER &

THE IMPOUNDMENT DEEPER,

WATER VELOCITY LOWER

14:30 SALMO RIVER

44-51 APPARENT TAILS @ CONFLUENCE

7 SAMPLE TAKEN

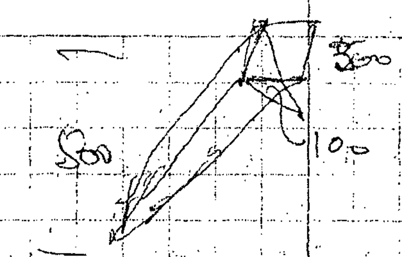
RIVER QUITE TURBID

REEVES - McDONALD MINE

8 SAMPLE - ROCK PILE

52-58 LARGE ROCK ~~PILE~~ PILE ON

SLOPE



$= \frac{500 \times 300 \times 100}{2}$

$= \frac{7.5 \times 10^6}{15/2}$

$= 500,000 +$

59-61 BRIDGE & LANDING FOR REMAC

1500 PEND OREILLE TAILINGS POND

63-68 NOTE LIMITED FILL

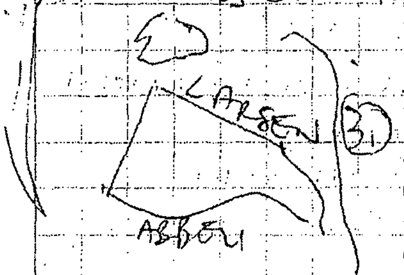
5:40 GRANDVIEW MILL & MINE

69-71 PHOTOS - EQUIP.

1545 GRANDVIEW MILL TAILS

DOWNHILL FROM MILL ~ 1/4 MILE

LOOKS LIKE IMPOUND.



4/29/10 POND OREILLE

72-77 TAILINGS IMPOUND AT BASE OF GRANDVIEW
WOOD LAUNDER AT BASE
TAILINGS APPEARS TO BE DEPOSITED BY FLOW FROM MILL

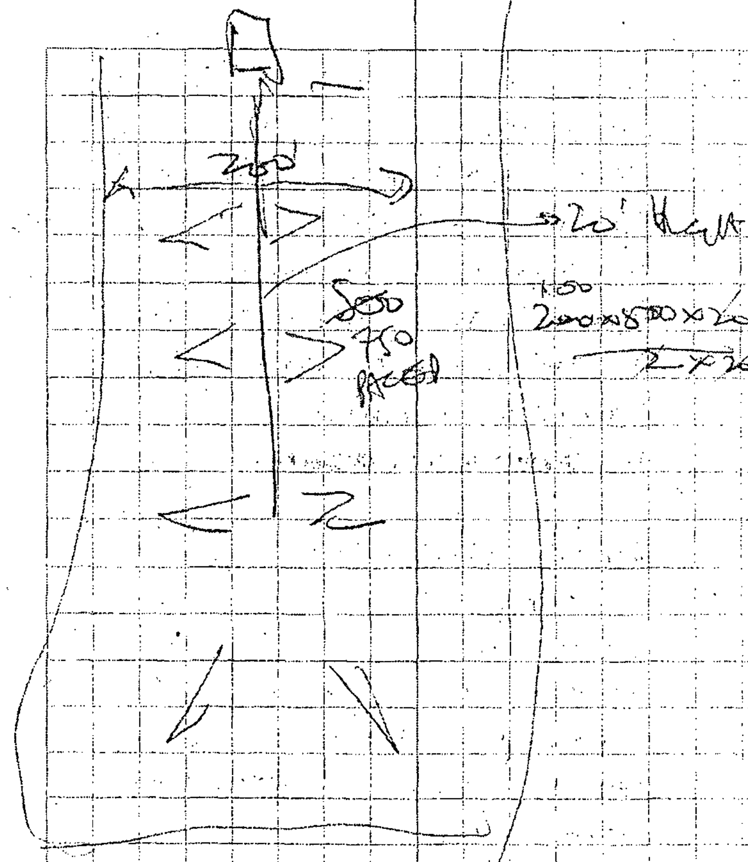
78-81 FLOW HAS XPORTED TAILS TO RIVER DOWN ~200' CLIFF.
TAILINGS VISIBLE IN CHANNEL ALL THE WAY DOWN.

18:20 SIERRA ZINC / ALLADIN

82-01 TAILINGS POND ABANDONED
NO GROWTH OVER MOST
DRAINED TO NE CORNER
XPORT DOWN ROAD & ROCK
DEAD GRASS BELOW

02-11 SOLID XPORT VIA ALADDIN CK
→ MILL BUILDINGS

12-18 XPORT PATHWAY → CREEK
NOTE DEAD GRASS



4/29/10 UCR

18:40 ~~DEEP~~ CREEK MINE

19-24 PANO @ GATE LOOKING W
WASTE ROCK &
VOLUME SMALL

19:30 ANDERSON CALHOUN
~~DEEP~~ LAKE

25-27 SHALLOW @ SOUTH END
~~DEEP~~ @ NORTH
ANDERSON CALHOUN
MILL WRECKED BUT SOME E/Q
TAILS SURROUNDED BY ROCK
BY EPA
IN FLOOD ZONE (STILL)

(11) SAMPLED TAILS

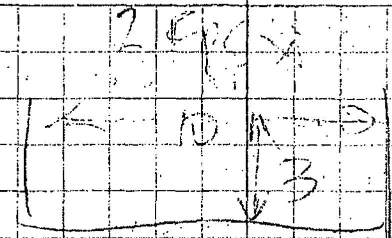
45-46 TAILS IN DITCH TO SEE XPORT

20:18 ~~ADER~~ BLACK SAND BEACH

(12) SAMPLED

47-49 PANO

AB 4/29/10



LAKE @ 1000 AF
500 AC @ 20' = 10000 AF

Q = 60 CFS x ~~[illegible]~~
= 60 x 2 ... = 600 AF/D

(5F) MARCY BALL MILL MINE & SMELTER

AB 4/29/10

4/30/10 UCR

9:00 BONANZA

67-72 ® INSPECTED ROCK PILES

73-90 ® INSPECTED MINE SUBSIDENCE AREA UP HILL

® INSPECTED FLOW PATH DOWN HILL

® SOME ARMORING/LINING OF WATERCOURSES

92-93 ® SINKHOLE OBSERVED

® DOWNHILL G/W FLOWPATH

94-106 + WELLS

AB 4/30/10

4/30/10 UCR

8:00 LEAVE COLVILLE

8:30 MARCUS FLATS/KETTLE FALLS

54-64 NOTE SLIDES ON FAR SHORE

AB 4/30/10

4/30/10 NORTHPORT

10:42 INSPECTED SMELTER SITE
106-116 LANDER DISCHARGE AREA
(13) QUENCHED SLAG
(14) POT RIM SLAG
(15) 300' FROM SHORE @ RIVER EDGE
(16) EXCAVATION IN RIM
117-126 DOWN TO 6"-12" REMOVING
ROX FROM SURFACE
NO END IN SIGHT
(17) AT NORTH END OF
SAND BAR
27-34 PANO OF RIVERBANK

AB 4/30/10

4/30/10 VAN STONE

215 TAILS
(18) CREST @ WEST - COARSE. OLD TAILS
WET
JOE BURRIS CARETAKER
(19) MINE ROCK (DOLOMITE?)
MINE POOL DISCHARGES TO
WEST
- TASTES METALLIC pH ~5
- STREAM TO WEST ~ ECFS
- VERY SWEET

- OUTLET 1" x 12" x 1 FPS

(20) ORE @ CRUSHER

13:30 INSPECT WASTE ROCK
77-89 INSPECT PIT
TASTE WATER (~~[illegible]~~) (OUTLET)
SOMEWHAT METALLIC
90-08 PHOTO PIT LAKE & WALL
09-10 DISCHARGE FROM LAKE
11-16 MILL BUILDINGS

4/30/10 BONANZA MILL
1500 VIEWED STREAMSIDE
18-19 (A) DROVE ON TO PROPERTY
(B) NO SIGNIFICANT VOLUME
OF TAILINGS ON SITE
(C) DIRECT ACCESS

4-30-10

Draft Upper Columbia River Sampling and Analysis 2009-2010

Field and Laboratory Activities

Greg Diefenbach

12/7/2010

The following reports are draft copies intended for use within another report.

E. Field Program, 2009-2010

1) Sampling Programs

a) Upper Columbia Observations, Trail to Waneta, September-November, 2009

b) Pend Oreille Coring Program, March 2010

i) Objective

ii) Personnel

iii) Hand Sampling Procedure

iv) Vibra-Coring Procedure

v) XRF Field Analysis

c) Upper Columbia River Coring Program, April-May 2010

i) Objective

ii) Personnel

iii)Hand Sampling Procedure

iv) Hand Coring Procedure

v) Vibra-Coring Procedure

vi) XRF Field Analysis

d) Suspended Sediment Sampling, May 2010

i) Objective

ii) Personnel

iii) Sampling Procedure

2) Findings

a) Fort Shepherd

b) Pend Oreille

c) Northport

List of Figures:

Appendices:

E. Field Program, 2009-2010

1) Sampling Programs

Multiple agencies, both public and private, have conducted studies of the upper Columbia River. Study topics have included water resources, mercury and metals contamination and bioaccumulation in fish tissues, industrial and agricultural organic pollutant bioaccumulation in fish tissue, slag in river and lake sediments, metals contamination from mines and mills in the upper Columbia watershed, metals contamination and industrial pollution in the Spokane river, metals contamination of beaches and recreation areas in and around Lake Roosevelt National Recreation Area. Studies have been conducted by the United States Environmental Protection Agency, United States Geological Survey, and the Washington Department of Ecology. Several studies have been conducted at the behest of the Confederated Tribes of the Colville, who depend on income generated from recreation, fishing, and casinos in the area.

A brief list of the major studies conducted since 1989:

WADOE – Johnson 1989
WADOE - Era and Serdar 2001
USGS/WADOE – 1998 Spokane Sediments
USEPA – Extended Site Investigation 2001
USEPA – Mines and Mill Report 2001
USEPA – UCR RI/FS 2005
USGS – SRC Bortleson 2001
USGS – Majewski 2003
USGS - Paulson 2003
USGS – Cox-2004
USGS – 2007 Cox and Paulson

Between September of 2009 and May of 2010, four field programs were conducted to collect sediment core, beach, mill tailings, slag, and suspended sediment samples from the upper Columbia River and its tributaries in northeastern Washington and southeastern British Columbia. The programs were conducted to qualitatively and quantitatively determine the lateral extent and genesis of metals contamination in the Lake Roosevelt/upper Columbia River system. Metals contamination in the Lake has been attributed to the Teck Cominco smelter at Trail, ignoring the potential contribution of mining, milling, and smelting wastes produced at multiple abandoned sites within the watershed. Sampling sites between Trail and Fort Spokane on the Columbia, as well as tributaries both large and small, were selected to represent various sedimentation regimes and contamination sources.

a) Upper Columbia Observations, Trail to Waneta, September-November, 2009

Conducted over two separate trips from September through November of 2009, the objective of the study was to observe flow regimes and depositional environments between Trail and the US border. A sample of coarse-grained, slag-enriched sediment from Fort Shepherd (river mile 748) was collected. This sample was delivered to Hazen for magnetic separation, sieve analysis, chemical assay, and QEMScan analysis.

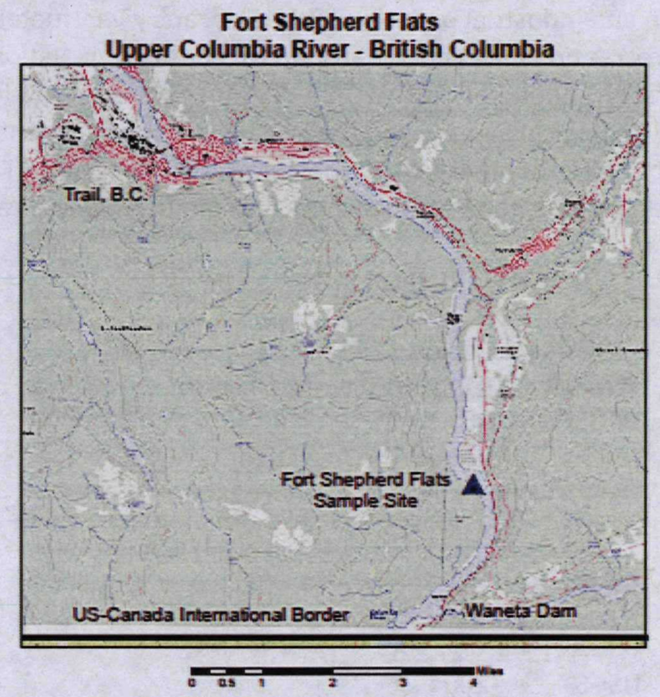


Figure E1. Fort Shepherd site at Columbia River Mile 748.

b) Pend Oreille Coring Program, March 2010

The Pend Oreille sediment coring program was conducted 9-11, March 2010 on the Pend Oreille River in British Columbia. Sediment cores were collected for the purpose of establishing the existence of upstream contaminants in the Pend Oreille River, analyzed in the field with an Innov-X Ω portable XRF and sent to Hazen for cold storage and chemical assay.

The Pend Oreille Basin in Washington and British Columbia hosted several large scale lead-zinc mines from Metaline to the Salmo River. Mining activities started in the late 1800's and peaked during World War II. Primary producers in the region were:

Grandview (US) – 1927-1964
Josephine (US) – 1920-1954
Metaline (US) – 1938-1948
Pend Oreille (US) – 1890-Present
Reeves-Macdonald/Redbird (CA) – 1948-1973

Most mining activities in the US ceased due to the depletion of economic ore but mining activities at the Reeves-Macdonald (ReMac) complex were terminated when the permit to discharge tailings directly into the river was not renewed due to new environmental laws. Several dams along the Pend Oreille effectively reduced bed-load transport of tailings in the latter half of the 20th century. Waneta dam was constructed by Teck Cominco in 1953 just above the confluence with the Columbia River to provide electricity for Trail operations. Sediments impounded in the Waneta fore bay have been shown to contain elevated concentrations of lead, zinc, arsenic and cadmium (Lewis to Penner, 2002). Boundary Dam was constructed at the US Canada border in 1964 by Seattle Electric. Seven Mile Dam was constructed by BC Hydro in 1977, roughly halfway between Waneta and Boundary Dams. Prior to dam construction, the Pend Oreille dropped ~700 feet in elevation over 25 miles from Metaline Falls to the confluence with the Columbia, an average grade of 0.55 percent. From ReMac, measured at the Salmo River, the Pend Oreille dropped ~425 feet in elevation over 12.5 miles to the confluence with the Columbia, an average grade of 0.64 percent. Normal pool elevations behind Boundary, Seven Mile, Waneta, and Coulee Dams in feet: 1950, 1725, 1510, and 1290 respectively.

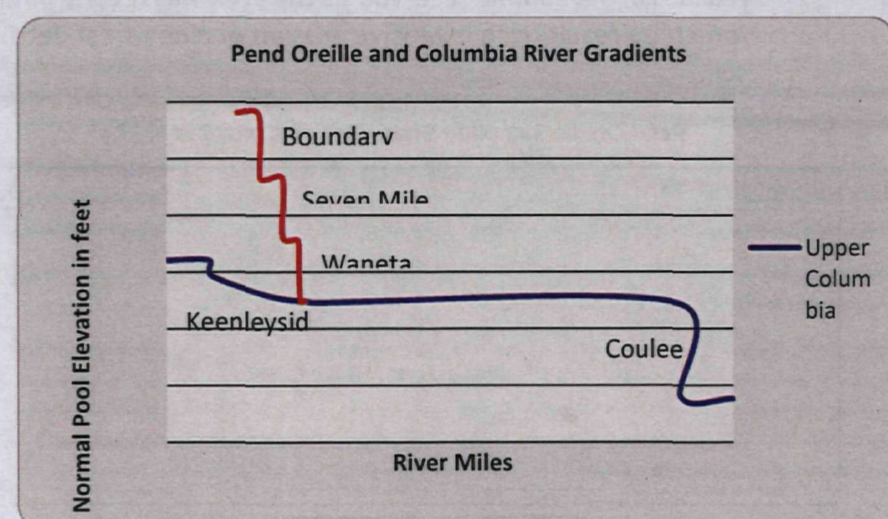


Figure E2. Normal pool elevations behind dams of the upper Columbia and Pend Oreille rivers.

i) Objective

The objective of this program was to determine the extent to which historic mining activities are represented in the sediments of the Pend Oreille River and the reservoirs behind Seven Mile and Waneta dams. Extensive mining operations are known to have existed along the tributaries of the Salmo River, at the ReMac site just above the confluence with the Salmo, and in the Pend Oreille drainage in Washington State (see: USGS Bulletin 550, USGS OFR 44-55, USGS OFR 44-55, USGS PP 202, USGS PP 489). The Remac area zinc-lead-silver-cadmium mines (Reeves-McDonald, Redbird mines) had extensive underground mining development including several thousand meters of adits and shafts, and significant surface disturbances including glory hole excavations of steeply dipping veins, and clear evidence of sulfide mineralization identified by iron oxide staining on the mine walls. Field observation noted oxidized, enriched outcrops consistent with the location of a mining district, which can lead to elevated natural background levels of metals. Field inspection also led to the discovery of placer mining operations on Waneta reservoir.

Field reconnaissance identified coring targets such as near shore shallow shelves, sand bars and beaches likely to collect soft sediments. Cores were collected in Seven Mile upstream of ReMac, below ReMac, up the Salmo and at its mouth. Cores were collected in Waneta upstream of, downstream of, and at a placer mining site. Center channel areas were found to be rocky except for the Salmo confluence which presented high concentrations of organic debris. Few cores were taken in the lower reaches of Seven Mile reservoir as the area was recently impacted by a forest fire resulting in extensive erosion of pine forest detritus and top soil.

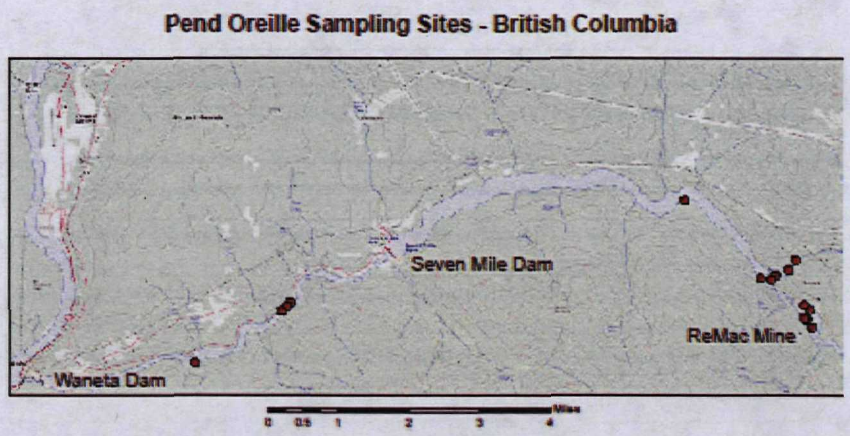


Figure E3. Coring site on the Pend Oreille, British Columbia.

ii) Personnel

Greg Diefenbach and Mike Brewer, consulting Geologists, were contracted to run the program, including site selection, sampling and sample handling, and chain of custody documentation. Shawn Kinz and Steve Saugen, co-owners of Gravity Environmental were hired to perform the coring on their company boat, *RS Palouse*.

iii) Hand Sampling Procedure

Hand sampling was conducted in the area of the historic Reeves-MacDonald mines above Seven Mile reservoir. Samples included waste rock, coarse rejects, and oxidized regolith soil.

iv) Vibracoring Procedure

Sediment Cores were collected by Vibracore drilling in five foot long, four inch outside diameter, clear Lexan tubing. Target sediment depth was 1m and actual core depths ranged between 11cm and 1.4m. Cores were extruded into a PVC trough and sampled at 5 or 10 cm intervals. Cores less than 20 cm were composited.

v) XRF Field Analysis

XRF readings were collected for each sample interval. The results were used to gauge the presence of metals in core intervals relative to other intervals and cores. XRF data is provided in Appendix E1.

c) Upper Columbia River Coring Program, April-May 2010

The EPA identified mine and mill tailings as a potential source of metals contamination in its 2001 *START-2* Mines and Mills study. Sample sites included tailings piles, mines, the Northport/Le Roi smelter site, and tributaries up and down stream of tailings piles, mines, and prospects. While several of the samples returned elevated metals content, this data was not included in the 2008 RI/FS. The purpose of the Upper Columbia River Coring program was to establish the existence of alternate sources of metals contamination within the Columbia Basin and identify those contaminants in the sediments of Lake Roosevelt.

i) Objective

Field activities from April 28th to May 7th, 2010 included hand sampling of surface sediments from beaches, exposed river bars, tributary over bank deposits, and tailings impoundment facilities, hand coring of shallow river bars, and Vibra-Coring of submerged sediment bars. The objective of this program was to determine the extent to which historic mining and smelting activities are represented in the sediments of the Upper Columbia River and tributaries. Samples were collected within the Upper Columbia River watershed in Washington State, between river mile 743 and river mile 657. Vibracore samples targeted sedimentation areas including river bends and sediment bars from Northport to Inchelium. Tributary samples included Deep Creek, Big Sheep Creek, Onion Creek, Kettle River, Colville River, Hunter Creek, and Alder Creek. Hand sampled beaches and sediment bars included Black Sand Beach, the Northport waterfront and Northport/Le Roi smelter slag discharge area, Dalles Orchard Beach, China Bend bar and boat launch, North Gorge campground and boat launch, Gregor millsite at Bossburg, Evans campground and boat launch, and several unnamed sediment exposures. Tributary tailings sources included the Iroquois, Anderson-Calhoun, and Black Stone mines on Deep Creek, and the Van Stone mine on Onion Creek.

ii) Personnel

Greg Diefenbach and Mike Brewer, consulting Geologists, were contracted to run the program, including site selection, sampling and sample handling, and chain of custody documentation. Shawn Kinz and Steve Saugen, co-owners of Gravity Environmental were hired to perform the coring on their company boat, *RS Palouse*. Gravity also provided a reconnaissance boat, *El Pescador*, and operator Mark Weber for river exploration prior to coring operations.

iii) Hand Sampling Procedure

Hand samples were collected at various depositional locations with the goal of representing the whole of the non-submerged area. Fine grained sediments were selected over coarse fractions to facilitate XRF analysis. Samples were collected at the surface and at depths up to 18 inches, field analyzed by XRF, and recorded by a site specific number with depth of sample, a brief description of grain size and color, and notes on any unusual characteristics. Sample sites were located by GPS for GIS mapping. All samples were stored at ambient temperature during collection and transport to the Hazen cold storage facility.

iv) Hand Coring Procedure

Hand cores were collected during boat and ground reconnaissance as well as Vibra-Coring operations. Gravity supplied a hammer-jack hand coring device which pushes 1 meter length, 2 inch outside diameter

Lexan tubes with sediment catchers into soft sediments. Hand cores were collected at or below waterline at several locations not conducive to Vibra-Coring or hand sampling. Hand cores ranged from 6 to 30 inches in depth and were sampled in segments of 6 to 12 inches.

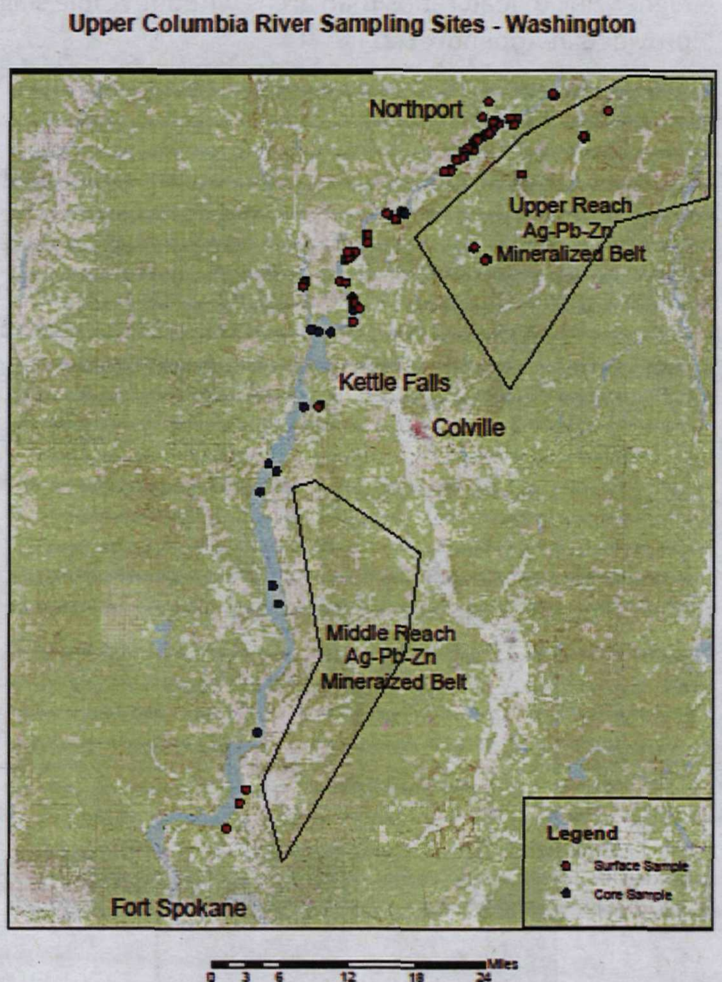


Figure E4. Coring sites and mineral belts on the upper Columbia River, Washington.

v) Vibra-Coring Procedure

Vibracore samples were collected in water depths of 3 to 95 feet using 60 inch length, 4 inch outside diameter Lexan tubes with sediment catchers, recovering 10 to 150 cm of sediment. Coring sites were chosen on the likelihood of hitting recoverable soft sediments in areas of interest. Cores were driven to refusal at bedrock or cobble, extruded into a vinyl trough, sampled at 10 cm intervals, field analyzed by XRF, labeled and bagged. Sections of recovered native coarse gravel were discarded.

vi) XRF Field Analysis

XRF readings were taken on each sample and core interval. Reported zinc and lead values were used to determine relative levels of metals contamination to distinguish slag/tailings impacted areas from non-slag/tailings impacted areas. Areas with visible slag were noted for having higher zinc to lead ratios than areas without visible slag. XRF data is provided in Appendix E 2.

c) Suspended Sediment Sampling, May 2010

Samples were collected on select tributaries of the Columbia River suspected of transporting metals from abandoned, shuttered, and active mining and milling operations within the Upper Columbia River watershed in Washington State. The Pend Oreille, Colville, and Kettle, and Spokane Rivers, and Onion, Deep, and Big Sheep Creeks, entering Lake Roosevelt or the Columbia River between USGS topographic series river miles 746 and 639, were sampled at one or more locations and one or more depths, depending on channel depth and accessibility.

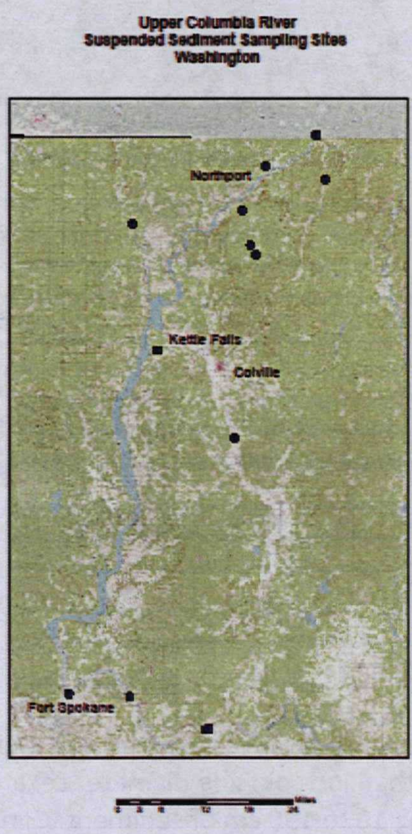


Figure E5. Suspended sediment sampling sites.

i) Objective

The objective of this program was to determine the extent to which abandoned, shuttered, and active mining and milling operations contribute to suspended and dissolved metals in tributaries of Lake Roosevelt and the Upper Columbia River. Tributaries suspected of carrying such metals were targeted, with sites selected near to potential sources and downstream of contaminated sites, or at in-flow points to the Columbia. The Pend Oreille River was sampled within the Columbia River, but at a point before mixing of waters had occurred. To differentiate, the Pend Oreille water was 51.5° F and green in color whereas the Columbia water was 44.8 ° F and Blue-black in color.

ii) Personnel

Greg Diefenbach, consulting Geologist, was contracted to run the program, including site selection, sample handling, storage, chain of custody, and shipping. Mike Duffield and Mark Weber of Gravity Environmental provided sampling equipment and operational support, including the use of the boat RS Wallawa. Eric Weatherman of Columbia Navigation provided the boat Mon-Ark for the Pend Oreille sampling. Smaller tributaries were accessed at stream banks reached by truck.

iii) Sampling Procedure

Suspended sediments were collected from 100 L of site water on several tributaries which enter the Columbia between River Mile 745 and 639. Water was drawn by peristaltic pump and passed through an in-line LISST particle size analyzer. Outflow was directed through a vortex separator attached to the pump apparatus followed by a 0.45 micron cellulose acetate filter (142 mm diameter). Water was pumped at 1 L/min for 100 minutes at each site. Some coarse sediment was collected by the vortex separator; the vortex separator is most effective at flow through rates greater than 2 L/min but the limited flow through of the filter required that pump rates be held at 1 L/min.

Sampling of the Pend Oreille and Spokane rivers was done from the deck of a boat, the RS Wallawa for the Spokane, and the MonArk for the Pend Oreille. Samples up to 8 feet depth were collected by fixing the collection tube to an anchoring weight suspended off the bow of the boat and dropping it a measured distance. For deeper sites, a GO-FLO was lowered to the appropriate measured depth, sealed, retrieved, and fed into the filtering apparatus. Smaller tributaries were sampled from shore by driving to an accessible location and setting the equipment alongside the stream. Tributaries were sampled as close to their centers as practical by attaching the tubing to a 6 foot stainless steel rod. The end of the tubing was placed up to 6 feet from shore at a position between the surface and mid-depth, with resulting positions varying from center channel to near shore rapids.

The sampling equipment consisted of a Sequoia Scientific Laser In-Stu Scattering and Transmissivity meter (LISST), Campbell Scientific peristaltic pump, 18 mm tubing, a vortex separator, which is a bottle connected below a 90° turn in the piping to collect heavy particles, a 142 mm diameter filter housing with a Geotech 0.45 micron filter, and an additional length of tubing out the end to for collecting filtered water.

"A" samples were collected in 8 oz wide mouth plastic jars from the vortex separator and from the filter housing. This "coarse" fraction was collected with a large amount of water relative to sediment mass, requiring transfer to 8 or 16 oz narrow mouth Nalgene bottles for shipping and storage.

"B" samples consisted of the filters from the filter housing. Filters were considered clogged when the pressure at the pump reached 15 PSI, the maximum pressure the system can maintain before hoses disconnect. This "fine" fraction was collected on folded filters in 8 oz wide mouth jars.

"C" and "D" samples consisted of post process water collected from the out-flow of the filter housing. These samples were collected in 1 L glass bottles on the first day. Sixteen (16) oz Nalgene bottles arrived for use the second day of sampling, and the previous day's samples were transferred from glass bottles into plastic. Eight (8) oz Nalgene bottle arrived for use on the fourth day.

"E" samples of unfiltered site water were collected over the last 3 days.

2) Findings

a) Fort Shepherd

The Fort Shepherd sediment sample was found to contain a high concentration of slag from the Trail smelter. Hazen performed a magnetic and heavy liquid separation to isolate the slag from native river gravels, resulting in a 95% pure slag sample representing 83% of the total sample mass. With the exception of mercury, mining and smelting related metals concentrations were elevated in the magnetic fraction relative to the non-magnetic fraction.

b) Pend Oreille

Hazen assay and analysis confirmed the field identification of mine tailings in cores E, F, and G from Seven Mile Reservoir below ReMac. Elevated metals, relative to the sediments cored upstream of ReMac and in the Salmo, were detected in cores Q, R, and T from Waneta Reservoir. Regolith soil collected form a road cut near the ReMac site reported, in µg/g: Ag > 100, Cd > 600, Cu > 1200, Hg > 16, Pb > 10000, and Zn > 10000.

c) Northport

The Northport/Le Roi smelter site is a potential source of metals contamination in the upper Columbia. The smelter, at one time the largest in the northwest, processed gold, copper, silver and lead during two periods of operation. During the second phase, the smokestack plume allegedly killed both the local dairy herd and the orchard. Slag was funneled through a pipe to a floodplain bench on the left bank of the Columbia. Significant deposits of Northport/Le Roi slag exist on the riverbank between the Northport boat launch and the highway 25 bridge. Post-smelter construction projects, the highway 25 Bridge and the Northport boat launch, resulted in the burial of local slag deposits at and downstream of the original discharge location. Upstream from the launch, slag cobbles were found near the ruins of the smokestack; sand size slag as a percentage of total depositional material increases rapidly towards the boat launch and the boulder dam which shelters the launch. Along the bar below the boulder dam, in an area submerged at NPE, slag particles from coarse sand to 8 inch cobbles comprised 50% of the surface material. Coarse Northport/Le Roi slags were sorted into six categories:

1. Flow-banded chips
2. Light, vesicular, brittle pumice
3. Pipe or trough shaped with rinding
4. Dense, iron rich slabs
5. Black, glassy, blocks with concoidal fractures
6. Heavy, vesicular, metallic spheres in amorphous matrix

Coarse slag particles continue downstream along a wash that drained the slag zone prior to Grand Coulee dam and construction of the current highway 25 bridge. Bridge supports obscure the drainage paralleling the river, though slag particles fining with distance support identification of this as a slag impacted floodplain. Coarse particles, flat and jagged with ¼ to ½ inch diameter, are abundant in two areas downstream of the bridge, a sandy cove on the south end of town with black sands >25% of total sand, and before the orchard, where slag particles of increasing size can be followed upslope perpendicular to stream flow in a dry wash. The latter is interpreted as a flood event. Geochemical and QEMScan analysis indicates that slag collected in the Northport area is not from the smelter at Trail.

d) Bossburg

During the ground reconnaissance phase, review of the *Orlob and Saxton* (1951) document led to identification of the Gregor mill site 1 mile north of Bossburg. Available records show the mill operated from 1941 to 1951 though this restricted period is inconsistent with field evidence. Local mines were in production in the late 1880's with concentrates shipped to the Colville smelter, side by side gravity fed mill units indicate two generations of mill construction at this location, and the BNSF railroad, relocated in 1938-39, includes a culvert under the grade so that tailings dumped on the flats below the mill would continue to be washed into the Columbia by seasonal flushing. Bulldozer leveling to develop saleable real estate lots has obscured evidence of operations below the mill, though abundant material is still present. The millsite and sediment bar directly below the mill were sampled, located and documented. ACT labs analysis of sediments directly below the mill reported lead concentrations of 2280-9780 µg/g and zinc concentrations of 8360 to >10000 (maximum detectable value) µg/g.

e) Colville Flats

The Colville River has hosted several sources of metals contamination, including a former EPA superfund site - the Bonanza lead-zinc mill at Palmer Siding, a lead smelter in Colville, a magnesium smelter in Addy, and extensive mining and milling for silver, lead, zinc, copper, gold, molybdenum, tungsten, iron, and manganese. While samples of fine grained sediments from the mouth of the Colville did not contain appreciable metals concentrations, a core collected on a depositional bar in Lake Roosevelt just offshore of the Colville Flats day use area above the historic floodplain is interpreted to contain tailings from the Colville River released during the reconstruction of Meyers Falls Dam in 1961. Core samples analyzed at ACT labs returned values of 1.58-1.76 µg/g Hg, 591-676 µg/g Pb, and 1490-1590 µg/g Zn. Extensive erosion in the lower Colville valley due to the filling of Lake Roosevelt has effectively buried any tailings remaining in the historic channel.

f) Campgrounds

All of the campgrounds between Kettle Falls and Northport, including Marcus Island, Summer Island, Haag Cove, Evans, and North Gorge, registered 800-1000 ppm zinc by XRF in the fine grained material at the swim beaches and outlying shallow depositional bars. *Macroscopic slag was not observed at these locations*, though prior channel sampling by the USGS and USEPA report finding slag in the coarse grained fractions of deep water grab samples. Microscopic optical analysis identified fine grained slag particles as <10% of total sediment in a matrix of crushed grains interpreted to be tailings.

g) Deep Creek

Deep Creek drains extensive abandoned and inactive mining operations, including the Sierra Zinc and Anderson-Calhoun complexes, and the Northport, Deep Creek, and Leadpoint mining districts. Tailings samples from the Black Rock, Iroquois and Sierra Zinc all reported high values of cadmium, lead, mercury, and zinc. The Anderson Calhoun mill was originally built to process zinc from the open pits and underground workings of the Anderson Calhoun mine. The mill was retooled to process precious metals enriched barite ore from the Flagstaff Mountain deposit from 1982-1984. An EPA evaluation in 2007 recommended: *Alternative 3 - Institutional Controls and Excavation, Limited Consolidation, and Containment*. Limited reclamation work funded in part by Blue Tee Corporation, the most recent operator of the mill, is complete as of 9/30/10.

H) Van Stone

The Van Stone silver-lead-zinc mine is the largest in eastern Washington and a source of historic contamination from mining and milling operations, including a 1952 Onion Creek fish kill traced to the accidental release of liquid effluent. Shuttered in the late 1990's, the open pits and tailings disposal facilities are maintained in accordance with the closure plan under the direction of Beacon Hill. On a site visit May 7^{th}, it was observed that runoff from the outer walls carried fine grained tailings material onto the road and into the Onion Creek watershed. Samples of tailings submitted to ACT labs assayed 811-1830 µg/g Pb and 3570-5860 µg/g Zn. The EPA collected five samples near the Van Stone for the 2001 ESI study. The stream sediment samples returned metal values near background, but it should be noted that all of the sample sites were upstream of the mine, mill, and tailings piles. Under the 2001 Mines and Mills study two samples were collected, one upstream of the upper tailings pile, and one adjacent to the lower tailings pile. Lead and zinc values were consistent with background and tailings, respectively.

3) Field XRF Analyses

Field analysis of soils and sediments using a portable, hand held XRF unit was used to identify sites and core intervals with elevated metals. This technology, coupled with field observation, allows for positive identification of mine and mill tailings, differentiation of metals contaminated soft sediments from native river deposits, and the depth intervals and extent of metals contamination in lake-bottom sediment cores.

a) Equipment and Methods

Field analysis was performed with an Innov-X Ω portable XRF unit equipped to analyze soils for elemental concentrations using a 30 second X-ray scan. While the unit can be programmed for hard rock and alloy analysis, the soil mode is preferred fro sediments. Pre-analysis standardization is performed with silica sand and NIST standard soil samples. Programming for light earth elements was not utilized, limiting readings to titanium and heavier elements. Lanthanide and Actinide series elements were not included. Sediments were analyzed directly under field conditions, including saturated core intervals and in situ site readings. Collected samples were analyzed through 0.4 millimeter plastic samples bags. Additional XRF analysis was performed on the samples selected for laboratory analysis at Hazen plus a selection of sample available as alternates. Samples analyzed at Hazen were dried, homogenized, and encapsulated in XRF sample cups with low-interference film wrap.

b) Elemental Analysis and Accuracy

Field XRF analysis is considered to be relative and unverified. Water content, organic content, gravel or pebble content, high iron content, and close proximity to refined aluminum can skew results. In the field, water and organics were commonly encountered, both of which read as a general dilution of metals concentration. Of the metals analyzed, iron, manganese, lead and zinc were the most consistent, registering about half of the actual value. Readings for cadmium and mercury tended to be inflated by factors of 10 and 100 respectively. Readings for chromium, copper and several other metals varied from high to strongly negative. XRF readings of dried samples generally reported values midway between the field readings and lab assay values for iron, manganese, lead, and zinc. Other metals remained inconsistent. See appendix E3.

4) Field Observations

a) Flow Regimes

Lacustrine and fluvial environments in Lake Roosevelt and the upper Columbia River vary with lake levels as controlled by the Bureau of Reclamation. Normal variation in pool elevation is listed as 1208 to 1290 feet above sea level. During peak normal drawdown, the Kettle and Spokane arms are rivers confined to their historic channels and the main-stem Columbia runs as a river to Kettle Falls. At lake levels of 1200 feet and below, a drawdown reached every five to ten years for dam and power plant maintenance, Kettle Falls runs as a waterfall. A drawdown of 100 feet is scheduled for the spring of 2011.

At NPE, Lake Roosevelt officially reaches Dalles Orchard Beach (RM 729), 6 miles south of Northport. The lake effect pushes an additional 14 miles upstream. The lake transition is marked by reduced current velocity and the submersion of historic river banks. River banks and benches stretch up to 100 yards wide from NPE shoreline to the channel itself. Relative submergence period is indicated by the thickness of vegetation on high points. During field operations in April and May of 2010, pool elevations at Coulee dam were between 1264 and 1270 feet, shifting the lower end of the lake transition zone to Bossburg (RM 716) and the upper end of the lake transition zone to the orchard off the south end of Northport (RM 734).

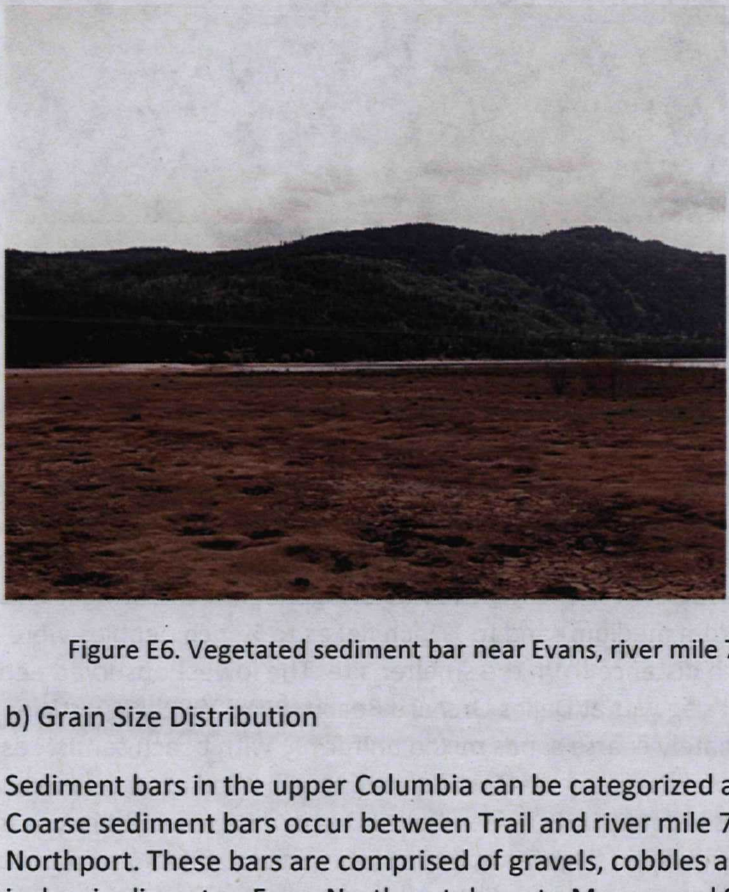


Figure E6. Vegetated sediment bar near Evans, river mile 712.

b) Grain Size Distribution

Sediment bars in the upper Columbia can be categorized as either coarse or fine. Coarse sediment bars occur between Trail and river mile 732 just south of Northport. These bars are comprised of gravels, cobbles and boulders up to 12 inches in diameter. From Northport down to Marcus and Summer Islands, bars tend to be medium sand to silt, with occasional pebbles on the upstream tails. Below Marcus Flats, no bars were exposed during site visits. Shallow benches at Colville Flats and Frenchman Point Rocks cored fine sand to clay with rounded pebble clasts in the lower core sections. Between Mission Point (RM 678) and Inchelium (RM 675), benches averaged 60 foot depths and cored silt to clay.

Figure E7. Cobbles over sand at the Northport bar, river mile 734.

c) Metallurgical Slag Deposits

Metallurgical slag was observed from Trail to Marcus Flats in channel and bank deposits. Between Trail and Northport, slag particles mix uniformly with coarse sand depositing on riverbanks, in river eddies, and between boulders in the channel. At Northport, extensive deposits of slag ranging from medium sand to ½ inch flakes to 8 inch cobbles were observed along the waterfront from the smelter site down to the Highway 25 Bridge. Below the bridge, slag particles ranging from medium sand to ½ inch flakes to ¾ inch pebbles were observed fining with distance from the smelter site. The lowest observed deposit of riverbank slag was at Dalles Orchard Beach (RM 729). Slag particles were predominately coarse sands mixed uniformly with beach sands. Lesser amounts of ⅛ inch flakes were noted concentrating in a band at waterline by flotation from the sand matrix. Between Dalles Orchard Beach and Marcus Island (RM 709), macroscopic slag was not observed in riverbank or sediment bar deposits, or shallow sediment cores. Channel cores were not collected above Marcus Flats due to the mechanical inability to recover particles cobble size or larger. A channel core recovered in Marcus Flats (RM 707) contained >75% slag in the medium to coarse sand particle range.

Figure E8. Coarse slags at Northport.

d) Mine and Milling Wastes

The upper Columbia watershed drains several highly impacted mining regions. Mines, mills, and smelters of the Coeur d'Alene district in Idaho are indicated as a source of metals contamination in the Spokane River, inputting at RM 639. Tailings from the Grandview, Josephine, and Reeves-Macdonald operations were dumped into the Pend Oreille River, inputting at RM 746. The Reeves-MacDonald mine closed in 1975 when the permit to discharge tailings into the river was not renewed. The Gregor mill at Bossburg (RM 716) dumped tailings into the Columbia until 1952. Wastes from mines, mills, and smelters in Stevens County have been reported or observed to impact Alder, Big Sheep, Blue, Deep, Hunter, and Onion Creeks, and the Colville and Kettle Rivers. Tailings ponds at the Anderson Calhoun, Sierra Zinc, and Van Stone facilities were observed as subject to aeolian and alluvial transport. Tailings pond breaches have been reported at the Cleveland mine. Bonanza mill tailings washed into the Colville until EPA Superfund clean-up in the 1980's.

Fine grained sediments with anomalously high metal concentrations by field XRF and no visible slag particles were identified as potentially contaminated with tailings. Field XRF analysis for slag contaminated sediments at Black Sand Beach reported ratios of zinc to lead between 40 and 60. Field XRF analysis for slag contaminated sediments from the Northport area reported ratios of zinc to lead between 2 and 40. Field XRF analysis for tailings form the Gregor mill at Bossburg reported ratios of zinc to lead between 2 and 7. Based on these field observations, fine grained sediments recovered in surface and core samples with no visible slag particles and zinc to lead ratios less than 10 were categorized as tailings.

Figure E9. Gregor Mill at Bossburg, river mile 716.

Figure E10. South high wall of the lower Van Stone tailings impoundment.

Figure E11. Tailings pile at the Black Rock mine on Northport-Aladdin Road.

Figure E12. Iroquois mine, Red Top district.

Figure E13. Sierra Zinc tailings discharge area, south fork of Deep Creek.

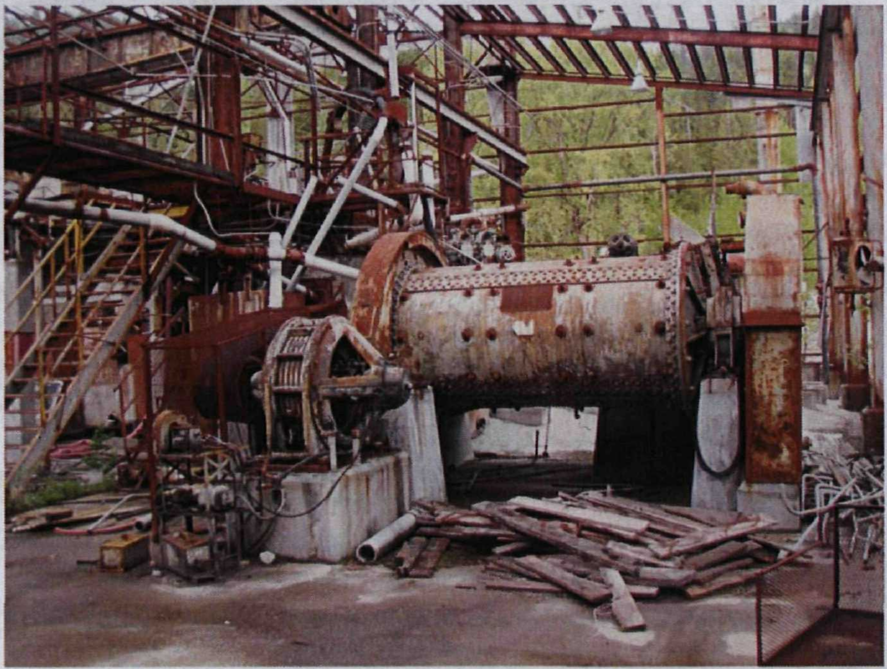


Figure E14. Anderson-Calhoun Mill, north fork of Deep Creek.

Figure E15. CERCLA remediation at the Josephine #1 Mill, Metaline Falls.

F. Hazen Laboratory Operations

Project oversight at Hazen Research was provided by Greg Diefenbach and Ron Schmiermund. Tasks included inventory and transfer logs, sample selection, confirmation of field identifications, microscope observations of magnetically separated and sieved fractions, XRF analysis of selected samples, and implementing procedural changes.

1) Optical Evaluations

Samples were evaluated optically following magnetic separations and sieve separations using a microscope provided by Hazen. Magnetic separates were examined to estimate the effectiveness of the magnetic belt separation process on +140 and -140 mesh fractions of samples containing slag or slag and tailings. Based on these observations, it was estimated that the +140 mesh fraction Fort Shepherd sample, after magnetic belt, rare earth hand magnet, and heavy liquid flotation separations, attained 98% slag in the magnetic fraction and 10% slag in the non-magnetic fraction. Subsequent slag-enriched samples were limited to magnetic belt separation and attained an estimated 90% slag in the magnetic fraction and 10% slag in the non-magnetic fraction. In the -140 mesh fractions, magnetic separation resulted in significant loss (>25%) of sample. Through optical evaluation of the fractions, it was determined that the magnetic fractions contained 90% clays and 5% slag particles. The non-magnetic fractions were primarily larger quartz and calcite grains.

2) XRF Analyses

To validate field XRF readings and ensure proper sample selection, XRF analysis was performed by Greg Diefenbach on samples selected for chemical analysis. The samples, under Tasks 3.2-3.5 and 4.1-4.3 plus the *General Interest* category, were dried in a nitrogen purged oven and magnetically separated and sieved in accordance with the Hazen Project 11177 Procedures. XRF calibrations confirmed that field results for iron, lead, manganese, and zinc were consistent and conservative, reporting 40% - 70% of the assay value. Readings for other metals were unreliable. XRF analysis of the dried samples returned values in between the field values and assay values. All samples except tailings collected directly at the Anderson-Calhoun and Sheep Creek mills returned XRF zinc values greater than the rejection value of 600 ppm. See Appendix E3 for field XRF data calibration.

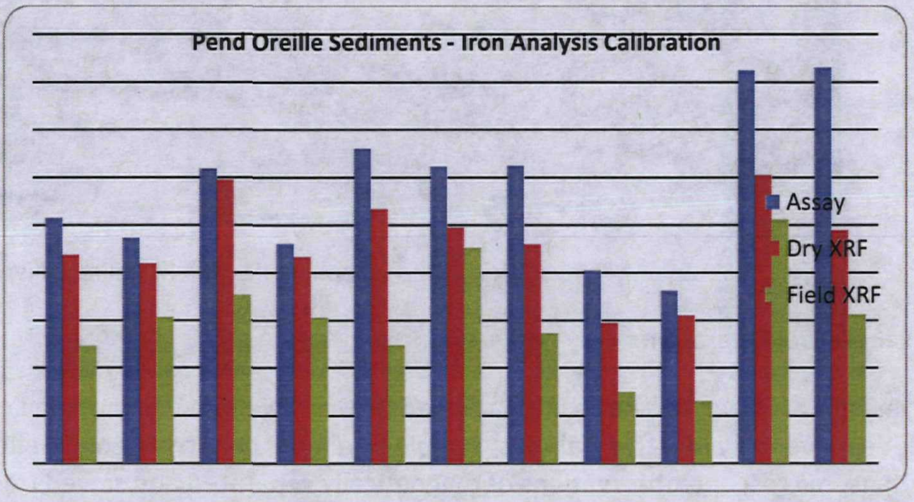


Figure E16. XRF calibration plot for iron.

3) Changes and Substitutions

a) Task 3.5

Task 3.5 examined sediments containing granulated slag collected immediately downstream of Northport. Following magnetic and sieve separations, it was determined that sample LR-17A had insufficient sample mass for the analysis procedures outlined for the task. Sample LR-31, collected 300 yards downstream, was used in place of LR-17A.

b) Task 4.1

Task 4.1 examined sediments likely to contain slag from one or more sources and tailings from one or more sources. The +140 fractions were magnetically separated to concentrate slag for analysis. The -140 mesh fractions failed to separate magnetically, with the magnetic fraction concentrating the clay size particles and the non-magnetic fraction retaining quartz and calcite grains.

Additionally, several of the samples lacked sufficient mass in either the magnetic or non-magnetic -140 mesh fractions for the analysis procedures outlined for the task. To address these issues, a procedural change was implemented and the -140 mesh magnetic and non-magnetic fractions were re-combined prior to chemical and QEMScan analysis.

c) Task 4.3

Task 4.3 examined tailings from mills and tailings ponds, and sediments likely to contain tailings. Of the samples selected for this task, three were collected in late May without the benefit of field XRF. These samples, from the Anderson-Calhoun and Sheep Creek mills, were determined by XRF analysis at the lab to be barite concentrate. One of these samples was excluded from the task and replaced with a sample of regolith soil collected from a road cut in the ReMac area. Another sample in Task 4.3, tailings enriched sediment from the Bossburg bar, was replaced by a supplemental sample of tailings from the Gregor Mill at Bossburg.

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